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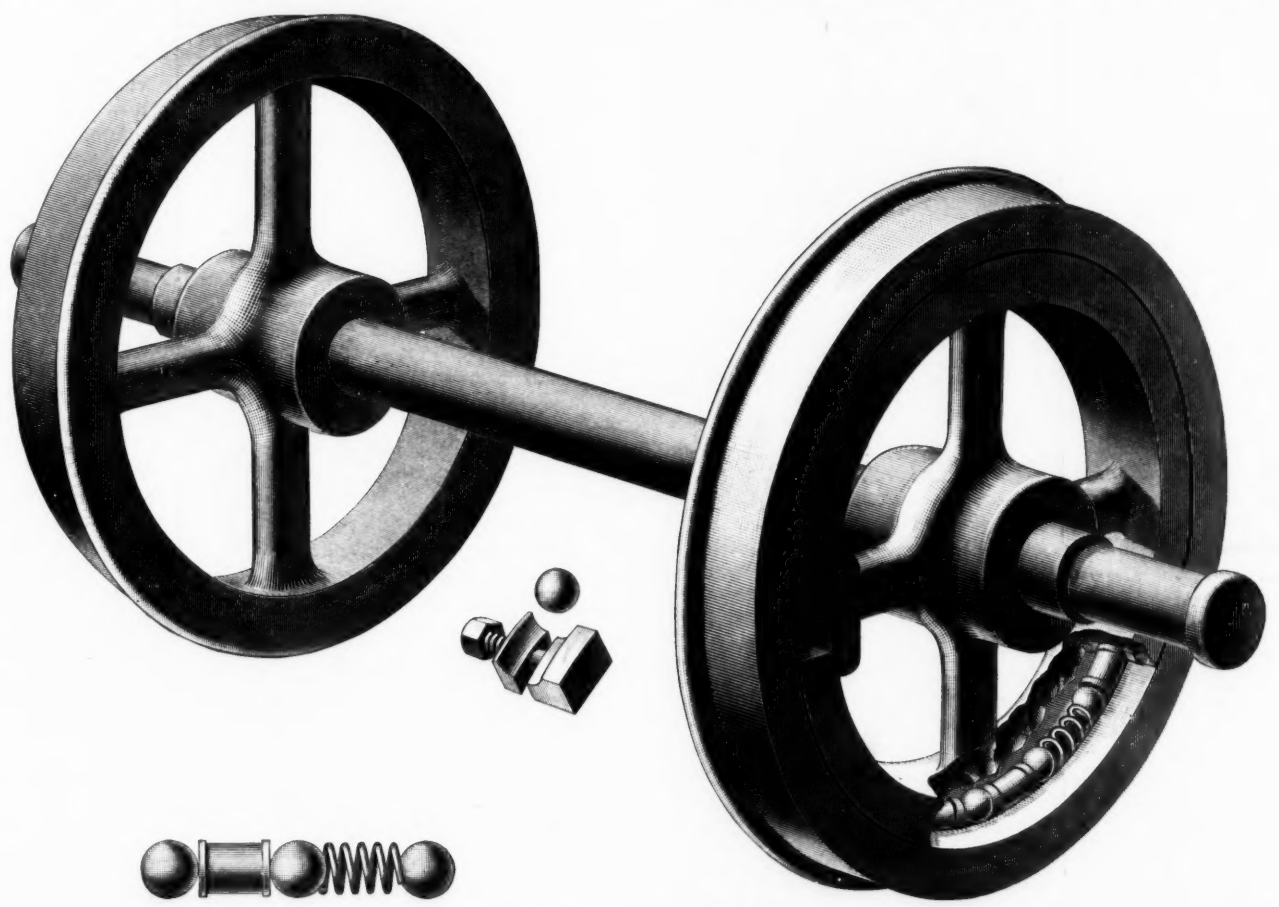
Compensating Car Wheel.

The accompanying illustrations represent an improved car wheel designed for the use on street railroads, tramways or roads over which comparatively light loads are to be hauled. The purpose of this wheel is to reduce the power required for hauling the cars over a curved track, reduce the wear on the wheels and rails, lessen the stress on the axle, and also lessen the danger of the cars jumping off a curved track. As will be seen in the illustration, only one of these improved wheels is used on an axle, the other wheel on the same axle being of the ordinary pattern.

The improvement consists in placing a loose tire on a wheel center, with spherical friction balls inserted between the two, enabling the tire to revolve freely and with very little friction around its wheel center. The friction balls work in suitable annular grooves turned into the inner surface of the tire, and also in the outer periphery of the wheel center. The friction balls are separated by wooden distance pieces with leather ends; these leather ends act as wipers, so that any dirt which may accumulate in the grooves will not injure the friction balls or prevent the tire from moving easily around the wheel center. At intervals a coil spring is inserted between the friction balls, for the purpose of deadening the sound and lessening the wear of the balls. A separate view of the friction balls, distance block and spring is given in our illustration.



COMPENSATING CAR WHEEL.

A cavity in the wheel center extending to the groove provides easy and ready means for placing the friction balls, distance pieces and springs into the grooves; and when all are in position the cavity is filled up by a plate and block, thus perfecting and completing the groove in which the friction balls work. The plate and block used for filling up the cavity are also shown separately. In the illustration of the wheel center the cavity when filled up is indicated.

The use of the friction balls working in a groove which is made up by a portion of it turned into the inner surface of the tire, and the other portion of it into the periphery of the wheel center, secures the tire on the wheel independently of steadying plates fastened to the side of the wheel center; consequently, when the flange of the tire is pressed against the rail, the friction sideways will be reduced to a minimum and the danger of jumping a curved track considerably lessened. Mr. Fred. G. Myers is the inventor of the compensation wheel, and has applied for a patent. We understand that these wheels are now being made at the Atlantic Works, East Boston, Mass.

Seamless Tubes Made from Solid Blanks.

Heretofore seamless tubes have been made from hollow ingots of metal, by passing the ingots between the opposed faces of diagonally-placed rolls, subjecting the ingots to an oblique compressing and rolling action, and thereby forming tubes of the required lengths.

The new method or process of making seamless tubes is based upon the discovery that hollow ingots, or blanks, for the formation of seamless tubes are not necessary, but that these tubes can be made from solid ingots, blanks, or bars of metal.

The various processes of the formation of tubes from solid blanks are shown in the accompanying illustrations; and since it is our purpose only to show and explain the principles of the processes based upon this discovery, we have simply shown the rolls and the blanks or ingots; all necessary gears for driving the rolls, and other details, have been omitted. In Figs. 1 and 2 (page 2) the rolls are marked A and a; the blank is marked B. As will be seen, the rolls have a conical shape; their axes must be properly adjusted in a diagonal direction. The exact shape of the rolls, and the position of their axes, depend on the effects sought for. In this particular case only two rolls are shown in approximately true positions, their axes lying in parallel vertical planes when seen from an upper position; and when looked at sideways, the axes will be seen to form angles with a horizontal plane, and inclined in opposite directions.

Consequently, in Fig. 1—which represents a top view—the rolls are shown as tipped in opposite directions, so that the large end A^2 of the roll A, and the small end a^2 of the roll a, are seen.

Three rolls (and sometimes four rolls) are commonly employed for simultaneously acting upon different sides of the blank; the use of three or four rolls serves to centralize the blank. On the other hand, when only two rolls are employed, suitable guides must be provided for properly supporting and guiding the blank. For the sake of simplicity of description, we have shown only two rolls, A and a, one on each side of the blank B; this blank, B, travels in a horizontal path between the convergent working faces A^1 a^1 of the rolls. The working-faces converge sufficiently to hold back the unacted-upon portion of the blank; and this shape of the rolls, in connection with the diagonal position of the same, will exert considerable pulling action upon the blank, and displacing the metal from the perimeter of the blank, by the impingement of the rolls, compelling this metal of the blank to flow forward and necessarily assume a tubular shape.

In Fig. 1 the blank B is represeuted as having just been engaged by the rolls A and a. The pinching effect produced by the rolls is illustrated by the annular flange b; by its forward projection from the front end B^1 of the blank the tubular formation is initiated. As the blank moves forward in its horizontal path, the flange b is correspondingly lengthened, and in this manner the tube is formed.

In Fig. 2 the tubular formation is represented as completed, and the cylindrical shell b^1 of the tube as issuing from the narrow end of the space between the two rolls. The rear end B^2 is represented in Fig. 2 as having been carried forward between the rolls, and exhibiting around its edge a slight annular projection b^2, which has been produced by the pinching effect of the rolls.

From this description it will be seen that one end of the tube always remains closed, so that this process is well adapted for the formation of tubes having one of their ends solid, formed from a solid blank.

The surfaces of the conical rolls A and a are, generally—although not absolutely necessary—provided with spiral ribs or corrugations, which give the working faces of the rolls a more effectual hold upon the parts of the blanks upon which they impinge, and owing to the fact that they gradually become coarser in pitch from the part of the roll which first engages the blank to the part of the roll which effects the greatest reduction in diameter, the spiral ribs have the effect of progressively drawing the metal from the outer portion of the blank inward and forward, and thereby greatly assisting in the development of the tubular formation.

In order to transform a blank into a tube which is open from end to end, the method shown in Figs. 3 and 4 is adopted, and which is specially useful for the manufacture of seamless tubing from solid blanks C, composed of iron or steel, which require to be highly heated preparatory to being subjected to the action of the rolls. In this method similar rolls are used as shown in the preceding figures, but in addition to these, a comparatively slender bar D is used, which is contained within the tube in the process of formation, and made to abut against and hold back the central portion of the blank, and to thus effectually oppose the tendency of the solid portion to move forward under the influence of the external diagonally acting rolls, the result being that the ignot or blank is transformed into a tube open from one end to the other.

In Fig. 3 the solid blank C (shown in longitudinal section) is represented as having been seized and carried so far through the space between the rolls that the tubular formation has been initiated, but the solid central portion of the blank has not yet been carried far enough forward to be brought into collision with the blunt end d of the holding-back rod D. The end d^1 of the rod D is stepped in a stationary box E, thus per-

mitting the rod D to rotate upon its longitudinal axis, but supporting it so that by the abutment of its end d against the solid central portion of the blank C it is enabled to perform its function of holding back the central portion of the blank.

Fig. 4 represents the conclusion of the operation, and shows the holding-back rod projecting entirely through the tube which has been formed, and having adhering to its end the small conical fragment C^2, which is sometimes punched out of the rear end of the blank C.

The employment of the holding-back rod D renders it unnecessary to reduce the diameter of the blank to so great an extent as is required when the holding-back effect is obtained only by the bearing of the blank against the convergent faces of the rolls, and it follows, therefore, that when the holding-back rod is employed, the solid blank can be transformed into a tube with comparatively little reduction in its diameter. The holding-back rod D may be made of a single bar of metal, or it may be provided with detachable head, which, if desired, may be slightly larger in diameter than the diameter of the rod. In Fig. 4 such a head d^2 is represented as socketed in the free end of the rod D.

When the metallic blanks are composed of metals or alloys which are so soft and ductile as not to require to be heated to a high temperature to fit them for subjection to the action of the rolls, then a cone-pointed mandrel B, shown in Fig. 5, is employed, which is arranged to project a prescribed distance into the space between the working faces of the rolls A a, and to penetrate the center of the forwardly progressing blank C, and thereafter to serve as an anvil or former, and over its surface the metal of the blank is forced by the reducing and stretching action of the rolls, the blank being thus transformed into a tube whose interior diameter is determined by the diameter of the base of the cone, and its exterior diameter is determined by the width of the narrowest part of the space between the working faces of the rolls A a. The rolls A a, Fig. 5, are feeding rolls, inasmuch as they perform the function of feeding the blank forward against and over the surface of the conical mandrel, and it will be seen that the apparatus may be employed for reducing the thickness of the shell of a tube already formed by enlarging its interior diameter. In Fig. 5 the rear end C^2 of the blank is represented as having been carried forward nearly to the pointed end b of the mandrel. The mandrel is generally made in the form of a movable or detachable head seated in the end of a long bar of smaller diameter than the inner diameter of the tube. The mandrel may also be made hollow and cooled by means of an injected cooling fluid; but for the manufacture of tubes from soft metal, solid mandrels are preferred.

Another process, is illustrated in Figs. 6 and 7, for transforming blanks of soft and ductile metals into tubes:

In this process the mandrel C is not a passive factor as before, but draws the inner metal forward, and thus co-operates with the external rolls in forming a tube of prescribed interior and exterior diameter. Fig. 6 is a top view, and Fig. 7 is a side elevation of a portion of a diagonal rolling machine employing a mandrel, the conical head of which is spirally grooved, and is placed midway between the two conical rolls A a. The working faces of these rolls are generally provided with spiral corrugation, as shown in Figs. 6 and 7.

The blank B is properly centralized for the delivery to the rolls, by being placed within the guide tube B', which is rigidly clamped to the table B^2 immediately adjoining the rolls. From the tube B' the blank B is fed into the wider end of the space between the rolls, and by the pinching effect to which it is immediately subjected the formation of the tube is initiated. Soon after, the forward end of the blank is brought into collision with the conical mandrel C, which for a portion of its length is provided with a spiral groove or grooves, the pitch of which generally becomes coarser from the point forward to the bas of the cone. The cone is attached to the mandrel shaft D; the opposite end of this shaft is squared and loosely contained in the quadrangular socket e formed in the end of the shaft of the pinion E, and suitable gearing is provided for rotating the pinion E in such directions and at such speeds as may be desired.

Inasmuch as the blank in process of formation into a tube is rotated by the action upon it by the rolls, the mandrel, if held stationary, will perform its function of assisting in drawing forward the metal engaged in its spiral grooves; but in some cases it may be desirable to lessen the extent to which the mandrel acts, which can be done by imparting rotation to the mandrel in the same direction as that of the blank, but at a less speed. On the other hand it may be desirable in some cases to increase the effectiveness with which the spiral grooves perform their function, and to effect this result the mandrel can be rotated in the direction opposite to that of the blank.

Another process of manufacturing tubes is based upon the discovery that by a suitable proportioning of the angles of obliquity of the diagonally acting rolls, and the length and angles of convergence of their working faces, they will operate to develop a tubular formation in any part of a solid metal ignot or blank which is submitted to their action, by causing a rupturing of the metal along the line of the geometric axis, as shown in Fig. 8.

The proportioning and the adjustment of the rolls are governed by the degree of softness and ductility of the metal which is to be operated upon; hence a different proportioning and adjustment will be required for the different metals, or even for the same metals at different heats.

The desired rupturing effect and radial displacement of the metal from the center of the blank are most easily effected by the employment of two rolls, which act respectively upon diametrically opposite sides of the blank.

The forces to which the blank is subjected in its passage between the rolls are of complex character. The two rolls act upon the opposite sides of the blank with a kneading effect, compressing the metal against which they impinge to a certain depth beneath the surface. The cross area of the metal thus compressed is indicated approximately by the section-lined triangle C C, shown in Fig. 9, which is a diagram of the blank in cross-section, representing the rolls A a arranged one above and the other beneath the blank C.

The direction in which the forces of compression are propagated from the places where the rolls impinge upon the blank is indicated by the arrows which diverge from the section-lined triangles C C respectively. It will be seen that the resultant effect of these forces is to impart to the part of the blank under compression a tendency to expand laterally, as indicated by the horizontal arrows C' C' pointing outwardly from the center of the blank.

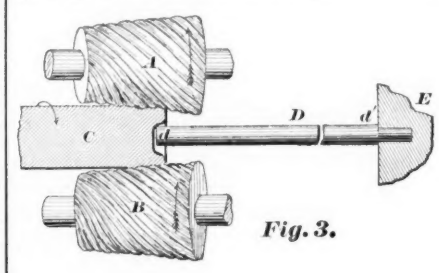
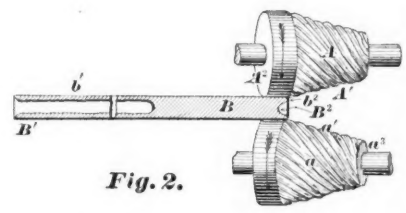


Fig. 3.



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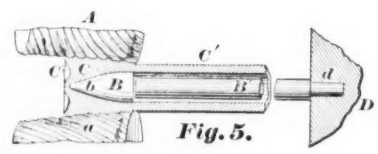

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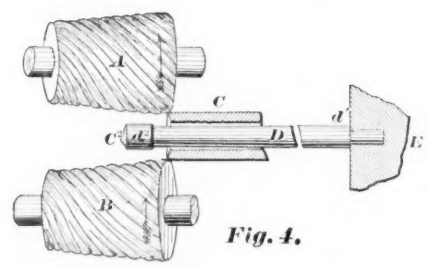
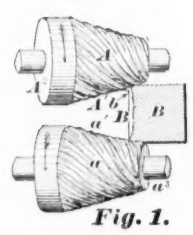


Fig. 4.



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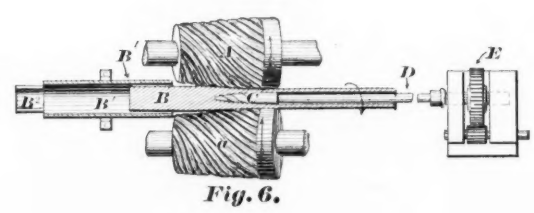


Fig. 6.

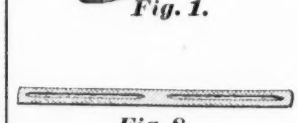


Fig. 8.

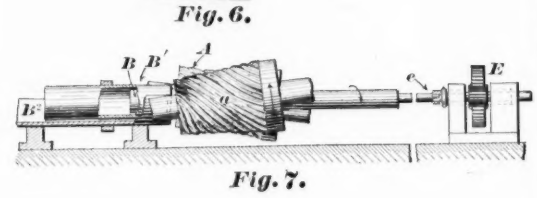


Fig. 7.

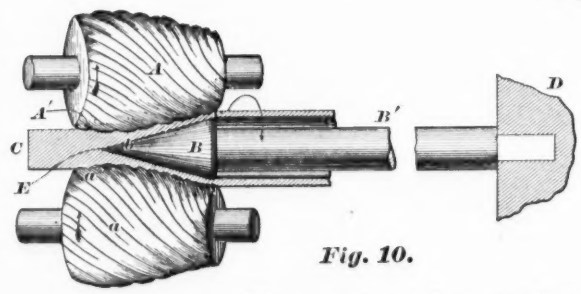


Fig. 10.

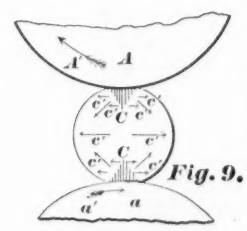


Fig. 9.

Manufacture of Seamless Tubes.

As the rolls are revolving in the direction indicated by the arrows A' a', and the blank of course revolving in the opposite direction, all parts of its circumference are in succession subjected to the kneading effect of the rolls, and thus the entire exterior of the blank is compressed, and thereby hardened to a certain depth beneath the surface, and all parts of the interior of the blank are successively brought into the position in which they acquire the tendency to expand in the direction indicated by the arrows C' C'. The final effect of this tendency is to cause a rupturing of the blank along the line of its geometrical axis, and the radially outward movement of the metal therefrom. There is, however, another influence exerted upon the blank, which assists in imparting to it the tendency to become hollow. This is the longitudinal stretching effect to which it is subjected by the rotation of the converging diagonally-acting rolls.

Tubes manufactured in this manner have their interior surface comparatively smooth, and the fibers of these tubes are continuous, and are overlaid spirally around the axis of the tube.

For the manufacture of tubes of copper and other comparative soft metals, and whose shells are of equal thickness, and their diameter larger than that of the blank, the following method, shown in Fig. 10, is well adapted. Here two or more barrel-shaped rolls, A a, are employed. When only two rolls are used, they are, respectively, arranged on either side of the axial line of a conical mandrel, B, which projects into the space between the working faces of the rolls, to such distance that its small end, b, is made to penetrate the central portion of the solid blank, C, after the blank has been engaged by the convergent portions A' a of the rolls, and has been thereby made to move forward, and over the surface of the mandrel. The mandrel, if desired, may be made hollow, and may be kept cool by the circulation of water, or other cooling fluids, through its interior; but it will be found that a solid mandrel will answer perfectly for operating upon blanks composed of copper or other similar soft and ductile metals or alloys which do not require to be heated excessively hot.

In the act of reducing the diameter of the blank, the metal at its surface is compressed and hardened, while the metal composing the central portion is not so compressed and hardened. The diagonal action of the rolls also has a stretching effect upon the metal upon which they impinge, tending to drive the metal toward and over the surface of the mandrel.

It results from the combined action of the forces to which the blank is subjected during its passage between the convergent portions A' a' of the rolls, that it acquires a tendency to become hollow, by the rupture of its central portion along the line of its axis; and the metal from the center of the blank tends to move in a spiral direction towards its periphery, in consequence of which comparatively small resistance is opposed to the penetration of the pointed end of the mandrel into the central portion of the blank. In some cases there may even be produced, in the center of the blank, a slight fissure, E, by the time the end of the blank has been carried far enough forward to reach the pointed end of the mandrel. It is not, however, necessary, in dealing with comparatively soft and ductile metals or alloys, that the blank should be actually ruptured before reaching the mandrel. Even if not ruptured, the tendency of the metal to move outwardly from the center, in obedience to the forces which have been described, diminishes the resistance opposed to the penetration into the center of the blank of the pointed end of the mandrel; and in either case the metal displaced by the impingement of the rolls upon the blank is forced forward with such energy that it is made to flow over the base of the cone, and to thus assume the form of the tube, the internal diameter of which is approximately determined by the diameter of the base of the cone, and the thickness of its shell by the distance between the surface of the mandrel and the parts of the working faces of the rolls which are nearest to the mandrel.

These processes, and others of similar character, are patented by Reinhard Mannesmann and Max Mannesmann, of Remscheid, Germany.

Cylinder Condensation.

By Wm. H. Harrison.

Much as has been written upon this subject, I have failed to note any reference to what the fathers knew about the action of the steam in an engine cylinder. I am the possessor of an English book entitled, 'Historical Statement of the Improvements Made, in the Duty Performed by the Steam Engines in Cornwall, from the Commencement of the Publication of the Monthly Reports. Compiled at the request of the British Association for the Improvement of Science, by Thomas Lean and Brother,

Registrars and Reporters of the Duty of Steam Engines, 1839."

As there is but one other copy of the book in this country, which copy I brought here and gave to a friend, your readers will pardon me if I make up this article mainly of *verbatim* quotations from its pages. In 1811 the engineers and owners of the Cornish mines started the scheme of publishing monthly reports of the "duty" performed by their pumping engines, and appointed Captain Joel Lean, a skillful and successful engineer, as their reporter. This business has been kept in the Lean family until the present time, the sons of Capt. Joel, the authors of the book, being the second generation, and the present Mr. Thomas Lean representing the third generation.

The introduction is a general statement of what was known to the authors regarding steam, and from this I now quote:

On applying the instrument called an indicator to an engine, which works expansively, it is found that the curve denoting the elastic force of the steam in the cylinder throughout the stroke is not strictly an hyperbola; but that the lines representing the power of the steam are greater than what is due to that curve, even when allowance is made for the steam contained in the nozzles and in the small portion of the cylinder between the piston and the cover at the commencement of the stroke. A little consideration of the nature of steam will explain this.

Then follows a table of pressures and temperatures which I will not give, as we have better ones now.

On reference to the foregoing table we see that steam, to have an expansive force of 50 pounds on the square inch (above zero) must be at the temperature of 280°, whereas the cylinder, owing to the unavoidable exposure of some of its parts, and the exhaustions which are continually going on, must stand at a lower degree.

When the steam, therefore, is admitted from the boiler, a condensation takes place, which continues as long as the steam valve remains open; and moisture is consequently deposited on the cylinder cover and piston.

Note here that nothing is said regarding condensation on the bore of the cylinder, as that part is thoroughly steam-jacketed, as were all of Watt's engines.

After the steam valve is closed, and expansion begins, this moisture is again converted into steam, and gives the appearance of a greater elastic force than is due to the expansion.

We have been thus particular on these two subjects—expansive working and the temperature of the cylinder, because it is chiefly by attention to them that the improvement of the Cornish engines has been effected.

Attached to Loam's engine at the United Mines is an apparatus which correctly measures the quantity of water injected into the boiler. In the last six months of the year 1838 we find that the quantity of coal consumed by that engine was 700 tons, and the quantity of water injected, 234,210 cubic feet, which gives fifteen cubic feet of water evaporated for every 100 pounds of coal consumed.

This was effected under a pressure of about 50 pounds on the square inch.

Thus was performed a very good experiment in evaporation on the large scale, which, reduced to our present method of measuring—taking a cubic foot of water at 100° temperature as 61.96 pounds—we have

$$\frac{61.96 \times 15}{100} = 9.294 \text{ pounds}$$

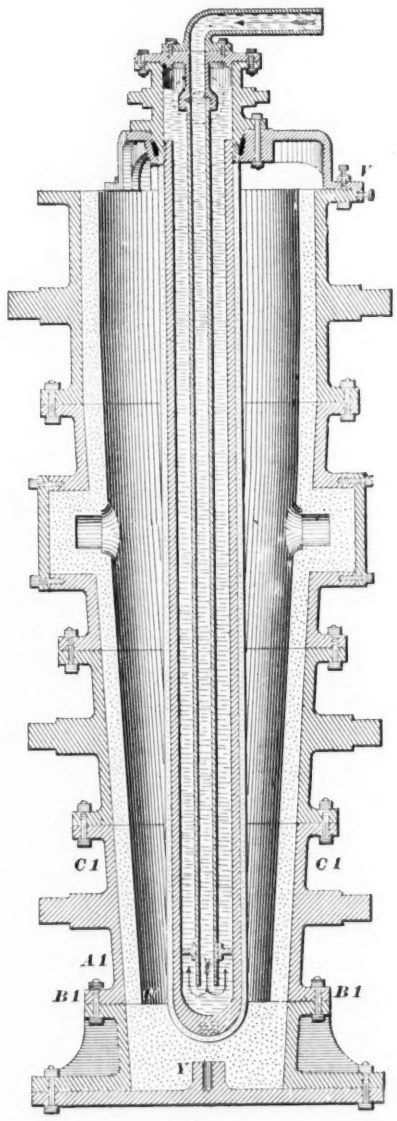
of water evaporated from 100° temperature of feed water for each pound of coal consumed. The nature of the "apparatus which correctly measured the feed water," I do not know.

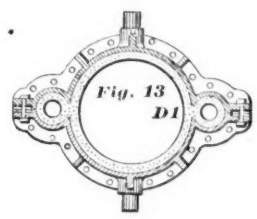
On the last pages of the book come some interesting reading:

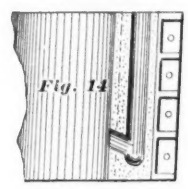
During the existence of Boulton and Watt's patent right, and for some years afterwards, many and strenuous were the efforts made by men possessing scientific knowledge, or practical skill, or both, to discover something new in principle, or some modification in construction, sufficiently distinct and definite, and, at the same time, possessing advantages enough to ensure them a share of the profits, without encroaching on the exclusive privileges of those patents. * * * * * * *

The first improvement deserving notice was the adopting of Trevithick's boiler, consisting of a long cylinder, through the whole length of which runs a tube having the fire within it. (These boilers are 6 or 7 feet diameter, of shell, and the "tube" or flue, which forms the furnace, 3 or 4 feet diameters. The steam pressure is about 50 pounds.) * * * * * They have now superseded the use of all others in Cornwall.

The advantages to be derived from the expensive properties of steam had been apparent from the first; and Hornblower had, at an early period, endeavored to turn it to account by using two cylinders and causing the steam, after having performed the stroke in the first, to act on the piston of another of double the capacity. But as the steam he used was raised but little above the pressure of the atmosphere, it was found that the power gained did not compensate for the inconvenience of a more complicated and more expensive machine. The same form of construction was long afterwards revived by Woolf, with steam of much greater power, and with considerable success. His second cylinder was four times the size of the first. To him we owe the establishment of the use of high pressure steam with expansion and condensation. Besides being an experienced engineer, Woolf was a skillful workman, and the engines erected under his superintendence excelled in correctness of construction.







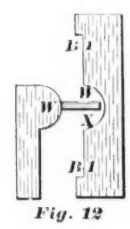


Fig. 12

Fig. 15

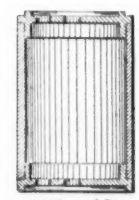


Fig. 16

It now appeared that engines well constructed might dispense with the second cylinder; the mere impetus of the mass of matter in motion being sufficient to carry the piston through three-fourths, or even a greater portion of the stroke, after the steam had ceased to be admitted from the boiler.

Little more remained to be done except to prevent needless condensation and waste of steam, and in this Capt. Samuel Grose took the lead by carefully covering every exposed part with a non-conducting substance.

Thus the engine was reduced to its simplest form—a single (acting) engine on Boulton & Watt's construction. And although our engines exceed in duty three or fourfold what Boulton & Watt had ever attained, or, perhaps, thought possible of attainment, yet they are after all in name and in reality Boulton & Watt's engines.

The master mechanic of the Iowa Central Railroad, Mr. John Player, has devised a new compound locomotive which is said to give considerable promise of success.

The cylinders of an ordinary locomotive are made use of as low-pressure cylinders, and others placed in front of these as high pressure cylinders. The valves of both the high and low pressure cylinders are worked from the same rocker arms. Means are provided for using steam direct from the boiler to the low-pressure cylinders, dispensing with the use of the high pressure cylinders whenever so desired by the engineer, thus making it, in effect, either a simple or compound locomotive at will.

Moulding a Cannon.

By Robert E. Masters.

The illustrations of moulding a breech-loading gun will not require much of a written description. With some the end of the core barrel rests in a chaplet secured on a flat surface at *U*. Where there is so much at stake the plan of iron to iron is not a good one; in the event of the flow of water stopping from any cause there is no possible chance for anything to give in the expansion of the core barrel unless it is loosened at *V*.

Cores 16 feet and 20 feet long have been suspended in moulds for muzzle-loading guns without any support, only where it is connected with the tripod, and as the butt in a muzzle-loader is cast down there is a great mass of iron below and around the lower end of the core. In a breech-loader the core does not require much support at the bottom, only enough to center it.

The two parts in Figs. 12 are matched at *W*. The stem *X* fits in the hub *Y*, and strikes out a print half the depth of the diameter of the core, the end of the strike bearing on the edge of the flask. After the different sections of the mould have been thoroughly dried, the lower piece is leveled in the bottom of the pit, and section *A*1 is leveled up on blocks on the floor. All the other sections are put on this and bolted or clamped together. The joints are dressed up and the core lowered into the mould and centered by the set screws (see article Oct. 1, Figs. 7 and 8). The board, Fig. 12, fits outside the flange of the flask at *B*1, and is a templet to hang the core by, so it will fit the print in the bottom; the tripod is then bolted fast to the flask and the whole mould lifted by the trunnions and closed on the seat in the pit. These gun casings or flasks when ready to pour are usually propped up in the pit. In extra large guns, where a "run out" or a break of any kind entails such great financial loss, it is a safe policy to ram up the casing in the pit; in the event of anything occurring, then you are likely to save your casting, and even if the casting is lost the hundreds of dollars of expense in getting the cheese out of the bottom of the pit, ruining the pit and gun flask would be avoided. If it is desirable to heat around outside of the flask after the gun is cast, arrangements can be made for that purpose.

The flask for a gun ought to be made strong, and be thick enough and ribbed and braced in proportion to the work. All sections of the flask part lengthwise, as seen in Fig. 13, which is a plan of the mould (without the core) from *C*1 to *C*1. The gun is poured from the lower end through 4½″ gates, shown in plan. Fig. 14 is a section of Fig. 13 at *D*1, showing the manner of gating, a gap being left in the rib that is between the sprue and mould to cut a gate large enough to take the metal free and fast.

The pattern is made in sections; the top section is shown in top and section view, Figs. 15 and 16. They are wooden staves bolted to cast-iron ends. The hand hole *E*1 is for bolting on the last stave, and the center hole in Fig. 15 is for keying on the shaft when turning the pattern off.

There is a hose connected with the supply pipe, Fig. 2 (Oct. 1). The water is turned on under pressure, and descending through the wrought-iron pipe within 3″ of the bottom of the core barrel, rises between the wrought and cast-iron barrels and discharges through pipe, Fig. 5. A steady stream of water is kept running through the core barrel before and during the pouring of the metal, and for two or three days thereafter, according to the size of the gun. This causes the metal next to the core barrel to set first; and continuing that way to the outside of the gun forms a compact, solid body. One would think the water from the discharge pipe in carrying off the heat from such a body of metal would be hot, but with a discharge of from 35 to 45 gallons per minute, the chill is barely taken off, and the hay rope is scarcely charred. Foundrymen will appreciate the havoc it would create should anything happen to the core barrel, or the least quantity of water get under the iron when filling the mould.

The time of starting the fires in the air furnaces, the quantity and quality of fuel used, and every point in the construction of the work, is made note of by the government officers appointed for that purpose. The iron is kept in a melted state in the air furnaces, and a small hand ladle dipped out every now and then, and test pieces taken until the iron is got in the right condition to pour.

Harper's Weekly, January 15, 1887, says: "The Tredegar Iron Works was the successful competitor against four other companies for a government ordnance contract." This was a long time ago, but there is one interesting point in connection with the competition that I do not know has ever appeared in any journal, and to which General Joseph R. Anderson called the writer's attention. The guns were of the Dahlgren pattern, bottle shape and cast solid. In testing the bars (that are taken from the mixture for every gun that is cast) in this trial, the irons in the Tredegar guns did not show as high figures for tensile strength and specific gravity as some of the irons used by the other firms. General Anderson, who has had an experience in iron products second to no gentleman in the United States, maintained that it was not the iron that stood the highest tensile strain that would stand the greatest shock from the discharge of gunpowder, and in the actual test this was demonstrated to the surprise of Commodore Morris. The Tredegar guns withstood the shock of the proof charges (which is much higher than a service charge) without any of them bursting. In testing the other guns some in each lot had bursted. A gun was selected from the lot made at the Tredegar works and tried with a duplicate set of proof charges without showing any detrimental effects except a little enlargement of the vent. Upon this report from the officer in charge of all the trials Commodore Morris ordered the gun to the navy yard.

The Milling Machine—Its Construction and Uses.

By John J. Grant.

The use of milling cutters is not necessarly confined to the milling machine either regular or specially made, but may be extended to the planer, boring mill, upright drill, or lathe, and often with a very small outlay for the necessary attachments or fixtures. While I certainly would advocate the purchase of a milling machine as one of the first tools, even in a small job shop, if the pocket-book will admit of it, still, a few special attachments fitted to the common gibbed carriage engine lathe will accomplish wonders in the milling line, and will serve as a substitute until a regular milling machine can be procured.

A few special fixtures like those illustrated in Figs. 1, 2 and 3 are about all that are wanted to make quite a milling plant in a small shop. A pair of centers fitted to the lathe carriage, Fig. 1, will be found very useful in fluting taps, reamers, straight shank drills, finishing bolt heads, nuts strung on an arbor, making small cutters and counterbores, splining short shafts and studs, cutting oil channels in stationary shafts, and in fact hundreds of jobs of a like nature that are usually done on a planer in a small shop. With the addition of an index plate of moderate size, small spur gearing can be as accurately cut as in a regular gear cutter. Those who have been employed in a small job shop would soonest appreciate a fixture of the above description.

A vise fitted in the same manner is equally as valuable, and will save as much in all varieties of flat work. With it all manner of keys, gibs, engine brasses, and every description of work not too large can be milled.

In doing work with these fixtures it is necessary to have the carriage clamped to the bed; however, as all first class lathes are now so made, it need not be shown here.

The stop generally used for screw cutting can be reversed and put on the back of the carriage of the lathe, where it will serve as a stop for the length to be milled.

The lathe must of course be run backwards, as the cut comes on the under side of the cutter, and the feed is from the operator. As there is a large range of speed, no attention need be paid to the diameter of the cutters, always bearing in mind that a small cutter is better than a large one for all kinds of work.

The attachments shown are fitted to a lathe having the gib slide raised, and, as will be seen, are made adjustable as to distance from center to center, or top of vise, to accommodate different diameters between the centers and various thicknesses of stock in the vise.

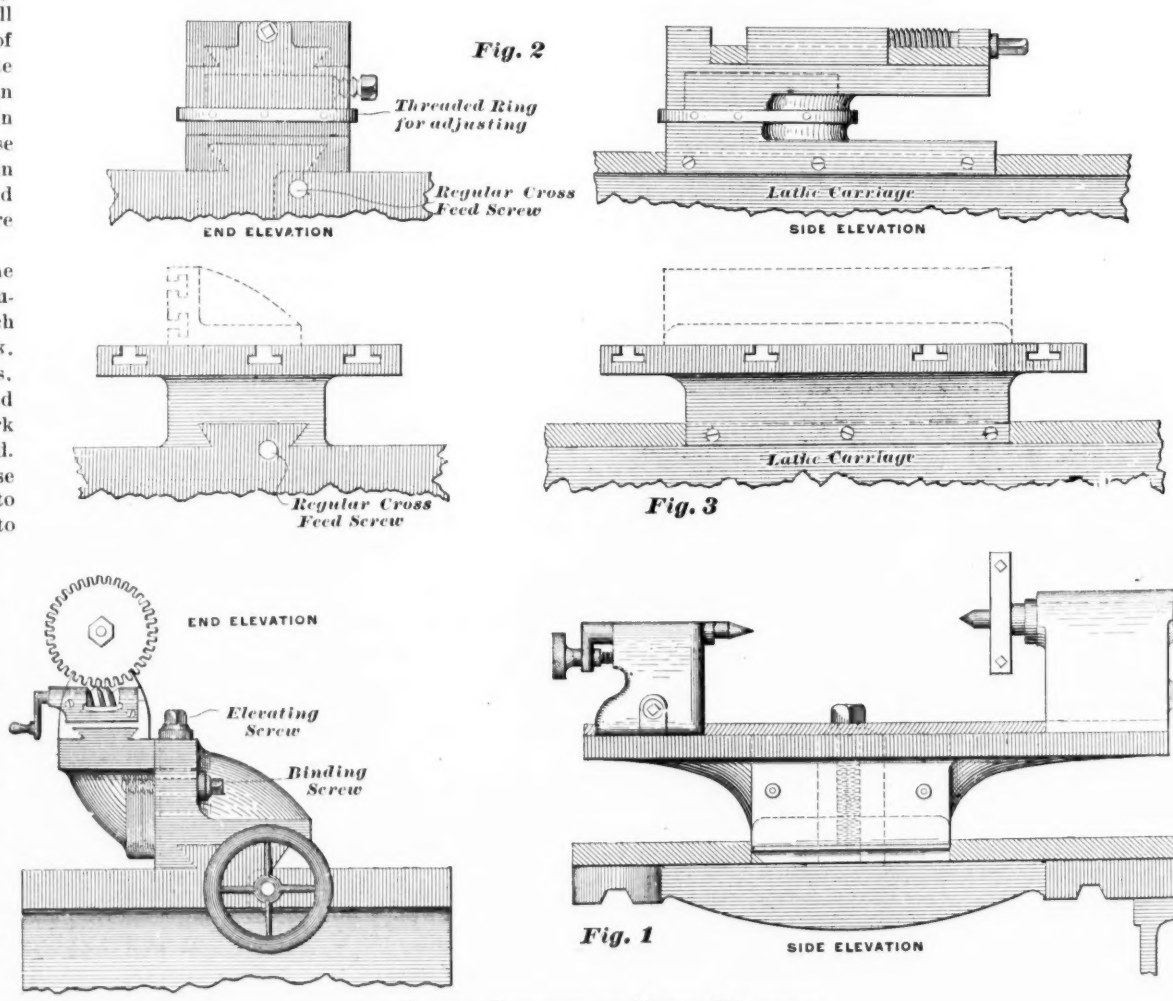
Cutter arbors can either be fitted to run between the centers, and be driven by the common dog, or, what is still better, fittted to the live spindle, as in the milling machine. Should the lathe have drill collets fitted to it, they can be used to fit all varieties of shank cutters. The vise is made to swivel on the center, as well as to adjust in height, and when placed with the jaws crosswise of the lathe and the foot stock removed, short pieces of stock, either round or square, for studs, standing bolts, set-screws, gibs, keys and the like, can be cut off far better, and in half the time it would take in the smith shop, with the advantage of perfectly true ends ready in the round stock for centering.

Another quite handy and cheap fixture is a platen, fitted in the same manner as the centers (Fig. 3), the size, of course, being in proportion to the size of the lathe. It should have T slots running through it, both lengthwise and crosswise; and with the addition of an angle iron, shown by the dotted lines, almost any job can be done, and especially with the end or face mill. In making this fixture, two birds are killed with one stone, as it is very handy as a boring table.

All of the above named attachments can be made for a 24″ swing engine lathe, including a few common straight cutters, for a sum not to exceed $125, and will pay for themselves, in a shop not having a milling machine, in the first six months of their use.

In making any such fixture, care must be taken to have all parts as rigid as possible, to prevent spring or jar, as far better work, more of it, and less wear of the cutters take place in a rigid machine.

In describing any such fixtures, it is impossible to enumerate even a small amount of the work that can be accomplished by them; but when the difference in the amount of work that is done on the milling machine and planer is understood, and when owners of shops learn that the cost for cutters, in the long run, is less than for the single-pointed planer tool, we may expect to see work done by rotary instead of the stationary single-point tool.



Special Fixtures for Milling Machines.

The Pilgrim's Broken Crosshead.

A noteworthy illustration of mechanical ability and skill was made apparent last Monday in the completion of a ponderous crosshead, by the Bridgeport Forge Company. The details are as follows: On the night of September 7, the steamer Pilgrim, of the Fall River Line, broke her crosshead while off Watch Hill, and was towed into New London by the steamer Bristol. The entire force of the Pilgrim at once set to work to remove the crosshead, and Mr. Peirce, supervisor of the Old Colony Steamboat Company, immediately went to Bridgeport, and proceeded to the Bridgeport Forge Company with the broken forging. Every nerve was strained, and every possible means utilized in its replacement, each day's delay entailing a loss to the boat of thousands of dollars. Some idea of the magnitude of the work performed may be had when it is shown that this massive forging, weighing in all about four tons, was forged, finished completely, and fitted up ready for replacing in the vessel at 10 A. M., the 11th. It was conveyed to New London by special train. Superintendent Peirce is highly elated at the creditable showing made by the Bridgeport Forge Company, under the supervision of Mr. Andrew Fletcher, and states that it is, without doubt, the greatest achievement of the kind ever accomplished. —*The Marine Journal.*

English Boiler Inspection.

By W. H. Booth.

SECOND PAPER.

In describing the general operations of the English associations, I will confine myself chiefly to the methods of the parent company, but note in passing certain differences in practice which have sprung up according to the ideas of the engineers of the later societies. Generally speaking, however, there is great uniformity of result.

Twenty or thirty years back, every boiler maker had his own pet ideas as to the construction of a steam boiler and the method of staying it, and such was the ignorance existing amongst some of them in regard to the principles governing the construction of boilers, that it is no uncommon thing even yet to find boilers of perfectly cylindrical form in which some ten or twelve bar stays extend vertically and horizontally diametrically across the barrel. These stays, perhaps formed out of two-inch square bar iron, have been thus introduced in the idea that they serve to strengthen a cylindrical barrel, though no doubt they have occasionally been found in a boiler sold by the pound weight, with the sole idea of increasing the weight. Then again, the staying of flat end plates varied according to each maker's idea, and end plates are still found stayed by longitudinal bolts by edge gussets, by flat gussets, by simple stiffeners, and by inclined bar stays. In the mode of setting, too, practice was no less varied, and every variety of arrangement was to be found; the flues surrounding some boilers being designed, apparently, as a puzzle for the flue cleaner, who could easily get lost in them, so winding and intricate were their labyrinths.

As the number of inspected boilers increased, and the inspecting staff multiplied, a store of information soon collected, and the first results of inspection were of course seen in a recurrence of reports upon certain defects which appeared almost universal. In this way, a defect of frequent occurrence would be found to be associated with a certain form of construction or the use of a special fixing, or of a certain feed water, and as one inspector after another would report similar faults it was not long before it became recognized that the cause was the same, and thus it came about that all the better class of boiler makers went willingly for information to the inspectors, and thus have grown up recognized standard rules, and general dimensions and plans of riveting, staying and setting which govern the trade, and the so-called standard boiler is the outcome of the collected experience of 30 years. The demand for a steady steam pressure in the Lancashire cotton spinning mills was rendered necessary by the fact that, until quite recent years, the steadiness of the turning power was very largely dependent upon a constant boiler pressure, as the old and universal Watt governor, actuating merely a throttle valve, was the sole device for controlling fluctuations of speed, and it was recognized that a boiler containing not only a liberal steam space, but also a large heat reserve, in the shape of a great mass of heated water, was best calculated to meet the demand for steady pressure. The double-flued cylindrical (or Lancashire boiler) best answered this description, and is now the universal steam generator in all large works in Britain, as many as twelve and eighteen being found set in one battery. Though some engineers have endeavored to replace the Lancashire boiler, nothing yet introduced has given equal satisfaction, and it appears likely for a long time to hold its permanence. We shall probably take an early opportunity of illustrating a boiler of this type with its settings and mountings arranged according to modern ideas. Though the dictates of steam users and the experience of inspectors both unite in placing the Lancashire boiler at the head of the list, there are, it is true, many other forms in use, especially where smaller power is required, or, as in iron works, where they desire to utilize waste heat from furnaces, has led to the employment of high vertical boilers of the Rastrick type, arranged to be placed readily in the center of a group of furnaces, all of which discharge their final gases into the boiler flues; of which more will require yet to be said.

The staff of a boiler insurance company consists of the chief engineer, who is usually a well paid man, getting from $5,000 to $7,000 per year, for which he is supposed to personally pass every boiler insured or guaranteed, and to take the responsibility; and of outdoor inspecting en-

gineers and office assistants. Many of the inspecting staff are men of ability and education, and for the sake of the experience to be gained a large number of such men have passed through the ranks of the different companies. This is less the case now than it once was, for the extreme cutting of rates, due to the competition referred to in our last, has had the effect of lowering the payments to the staff and the recruiting of fresh inspectors of a lower grade, men of education being informed that they are not required. "We don't want to engage good men now," was recently said, "but any steady man who can write legibly but not grammatically will do for us, for we cannot afford to pay such rates as will keep a good inspector contentedly with us." In consequence of this policy governmental interference has taken place, and the position of the English steam user is likely soon to be one of annoyance.

In addition to the engineering staff there is the necessary clerical and business department.

When a boiler owner wishes his boiler to be insured or guaranteed, or simply inspected, he notifies the company which he may select, who send their inspector to make the survey. This, to be thorough, includes an internal examination of the boiler in a cool state, and the report includes a fully dimensioned sketch showing the disposition of every plate, the nature of the riveting and the arrangement of fittings, etc.—the size of all openings in the shell being carefully noted and the dimensions of strengthening rings. Faults, such as fractures, corrosion, bad staying or insufficient rivets, are specially noted, and the general condition is taken into account as well as the quality of the workmanship. The examination extends to the brickwork flues, which should show no trace of dampness, and all corroded places are measured and leakages noted, as well as every part being sketched and dimensioned. Internally the condition of the fittings and the arrangement of all pipes, blow-out taps and valves is shown on the sketch, and a general report as to keeping, attendance, etc., is included, and from the report thus sent in, the boiler is estimated by the office staff as fit for a certain pressure. It is one of the highest attainments of the inspector, to be able not merely to satisfy himself as to the condition of a boiler, but to be able in his written report so to describe its condition and environment as to enable the office staff to appreciate these conditions just as if the boiler were before them.

The office staff is thus entirely dependent upon the working outside inspector, and every effort is made to fix responsibility as much as possible upon the inspector. A very strong feeling exists amongst these latter against being thus saddled with a responsibility for which other men are paid, and it is pretty certain, then, in event of any serious explosion causing loss of life, the blame would be found to attach to the chief engineers rather than to the underpaid and overworked inspector. It is acknowledged that to make a thorough inspection of four full-sized Lancashire boilers in a day is as much as ought to be required, assuming, of course, that the boilers are not quite new, but of some age, and with faults to be noted. Now it is common to give five, or six or more for a day's work, and the result cannot be satisfactory in many cases, especially as is so often the case, one or more of the number are unfit, by reason of heat and moisture, for inspection.

This mischievous outcome of rate cutting is not due to the better class of steam users, but to the meaner firms, both large and small, whose sole idea in boiler inspection is to shirk responsibility which falls upon the insuring company. It is no uncommon thing for a large steam user, when refused a certain working pressure, to hawk round his insurances until he can get some company to undertake the risk at his pressure, and it is a frequent reply to a refusing company to say, "Oh, very well, if you don't want my boilers the A and B or the X and A Company will give me my pressure." The slow growth of the parent society, and the difficulty experienced in keeping business by the more conscientious of the later companies, is proof sufficient of the fallacy and wrong-doing at present existent. The threatening interference of the Government, which makes a mess of everything it undertakes, is likely to do an immense injury to both. Government officials in Britain resemble mules—they possess neither reason nor argument; there is practically no appeal beyond their decisions, and instead of being public servants they are public masters and a public nuisance. The incompetency and incivility of the civil service is proverbial, and yet steam users are willfully allowing such a state of affairs to engender as will lead to State control of steam power with most regrettable results.

Two systems of inspection are followed; the first, that of the parent society, being to locate all their inspecting staff near headquarters, every inspector living in the city of Manchester. Every week he receives a sheet of visits to be made, and proceeds by train or boat perhaps as far as London or South Ireland, remaining away until his round is completed and returning to Manchester. The other method, followed by all the other companies, is to locate an inspector in a certain district, the whole country being mapped out into districts. Each plan has its advantages and drawbacks. In the first it is, perhaps, advantageous that the same inspector rarely examines a boiler twice in immediate succession. Each enrolled boiler is examined by many men; and what one man fails to notice another sees, and a check is also placed upon the reported depth and extent of corrosion and fractures, and generally, two heads being better than one, the state of the boiler is better known through a multiplicity of observers. On the other hand, it is argued in favor of the newer system that, apart from the saving effected in traveling expenses, it is a positive gain that one man should repeatedly examine the same boiler, as he thus becomes so familiar with all its peculiar faults that he is better able to know when any change occurs in its condition or mode of working. But, again, it is argued against the newer system that inspection is liable to be performed in a perfunctory manner, and doubtless with an inspector too wary of conscience, such a contingency is indeed very likely to arise, and some very amusing stories are told bearing upon the human tendency to err, which has been shown up occasionally under this system, not that the older system does not afford its quota.

When the inspector's report goes up to headquarters, it is dealt with by the office staff of engineers, whose chief duty—and a very monotonous and dry duty it is—is to read the inspector's reports, and write out a short digest of them to the boiler owner. In the majority of cases, this work is pure routine, the occasional more difficult cases being referred to the chief. Really sound engineering advice cannot be got for the money expended per boiler, and it is not usual that any great economy of working is secured as the result of the ordinary service of the inspection companies; but steam users are inclined to place more value than is properly its due upon inspection, with the result that experts in private practice can find little employment, and no special economy, in the production and use of steam, results. Properly conducted, inspection is tolerably certain, however, to prevent boiler explosions, if the advice given to the boiler owner be acted upon; but, as we have said, the advice is too frequently neglected, and the insuring company, for business reasons, still continues to grant the policy, the folly of which proceeding is periodically brought to the front by the disastrous blowing up of an insured boiler, accompanied by heavy loss of life.

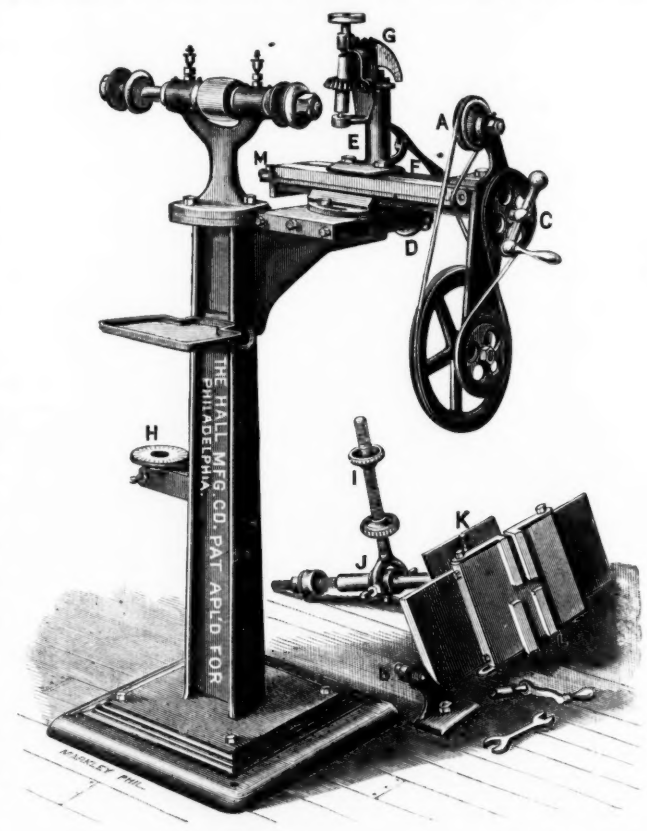


Fig. 2.

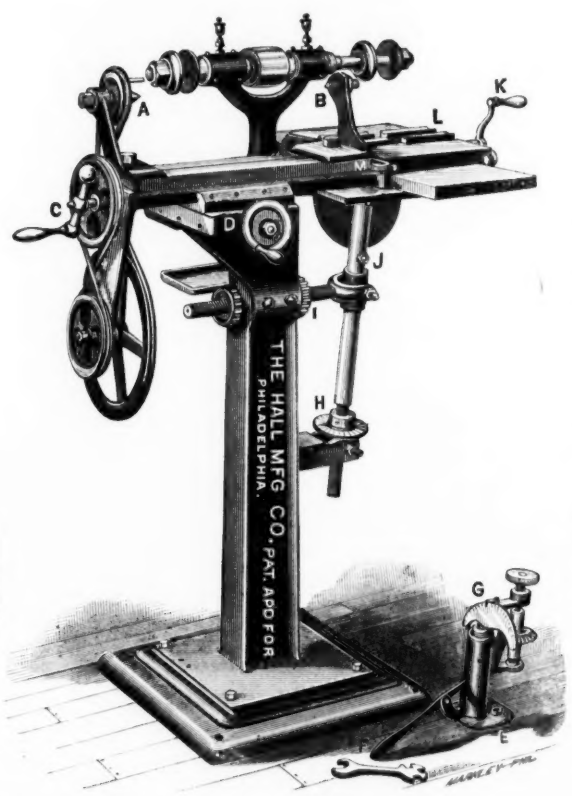


Fig. 1.

The Hall Emery Grinder

The Hall Emery Grinder.

The engravings represent this emery grinder, with some of its attachments. The emery grinder proper carries two wheels, the spindle running in split composition boxes, the journals being protected from dust by brass caps and leather packing.

The grinder, with the cutter and cylinder, grinder attachment, also the surface grinding attachment, is shown in Fig. 1. In this form it is designed by the manufacturers to meet the requirements of tool makers and general machine shop work. The mandrel, reamer, or other piece being ground is held between dead centers. The bed is adjustable to an angle, so as to grind across the corner of the wheel. A vernier provides for setting to grind tapers.

Fig. 2 represents the vertical cutter head attachment. This attachment is easily adjusted by means of the **T** slots in the bed of the regular universal cylinder grinder, or it can be supplied with its own slide and bracket where that bed is not needed. It is a holder and guide for grinding all sizes and shapes of straight, spiral or angular cutters, and mills with straight or irregular faces, and angles to three inches in diameter, or for backing off, and is adjustable to 90° either way from the vertical.

It takes in arbors or cutters 3½ inches long. The perpendicular adjustment of the angles is read upon a dial opposite the centers and facing the operator. The lateral angles are determined by the vernier at the base *E*, both graduated to degrees. The perpendicular movement of the work along the course of the wheel is made by the lever *F*, and the movement across the face of the wheel is secured by the screw *C*. Guages are supplied for the proper locating of the teeth of the cutter to be ground. Countershafts accompany each machine.

The manufacturers are the Hall Manufacturing Company, Philadelphia, Pa.

The steel rail manufacturers, in fixing the allotment for next year at considerably below the normal output, have no other apparent object in view than to keep prices abnormally high. This will make room for a good deal of importation, and circumvent the objects aimed at by the supporters of a protective tariff.

The latest plan, and it is a good one, is elevators to take passengers up to the stations on the elevated roads. The first one put in is at one of the high stations on the Sixth Avenue road; this was established by property owners to increase the rental value of property. It seems altogether likely that such elevators will become common on the elevated roads, at least at the more important stations.

LETTERS FROM PRACTICAL MEN.

The Canal Boat Problem.

Editor American Machinist:

While friend Couch admits in his letter on the above subject that you were right in your statement, I believe a large majority of your readers will conclude that he thinks it takes the same water to lock a light boat up that it does a heavy one: but as you stated in the original article, people arrive at these conclusions by beginning too late or stopping too soon. Mr. Couch is unquestionably correct in his statement so far as he goes, but does not state that when the large boat is drawn into the lock that a large amount of water is forced out, and when a small boat is drawn in, but a small amount is forced out. So if the reckoning is made from the lower gate and the lock returned to its original condition, it will be found that more water has passed the lower gate with the large boat than with the small one. Similarly, if the reckoning is made from the upper gate, it will be found that after the large boat has been drawn out of the lock it will take more water to fill the hole than when the small one has been drawn out.

So too, if we assume the lock to be in either condition full or empty, and return it to the same condition, and estimate the amount of water that passes either gate, we will find that it takes less water to lock a large boat down than a small one.

This is a case where carrying the proposition to an extreme shows up the reasoning in an interesting light. Assume that a chip of 1″ displacement is to be locked down and the lock stands full of water. The chip is floated in from the upper level and drives one cubic inch of water back past the upper gate and the gate is closed; the water is drawn out of the lock to the full fall, say three feet, the lower gates opened and the chip floated out, and one cubic inch of water flows back in and fills its place. The lower gates are closed. At this point three feet of water have passed out of the lower gate, and one cubic inch has passed back. So you have the lock full, minus the cubic inch past the lower gate. Next, return the lock to its original condition by allowing the lock full of water, three feet, to flow in, and you will have a lock full of water minus the original cubic inch past the upper gate.

I believe no man can say or will undertake to prove that the foregoing statement is not absolutely correct, and if we carry the proposition to the opposite extreme we will find it more interesting.

Assume the lock to be as before filled—three feet fall—and a boat coming in from above drawing four feet of water, and exactly as large as the lock; an impractical thing of course, but assumed so to make the case extreme. Now, when this boat is drawn into the lock, four feet of water is forced into the upper level, the gates are closed and the boat lowered the three feet. That is, three feet of water, full size of lock, has passed down through the lower gate; the boat is drawn out and four feet of water flows back to fill the space, and the gates are closed. No more water will pass the lower gate in either direction, and three feet only passes down stream and four feet up stream. Now return the lock to its original condition by drawing in three feet of water from above, and we have three feet of water passing the upper gate down stream against the four feet that was forced back into the upper level at the beginning. Hence we have a certain amount of water actually pumped to the upper level.

The old canal boat captain who has run a boat fifty years says he knows better; that a boat going down don't pump any water up to the upper level, and he is more than right about it; for boats are not the full size of a lock—seldom draw more water than the depth of the lock—and the leaking and flushing often use up more water in locking a boat down than up.

John E. Sweet.

It Wasn't Perpetual Motion.

Editor American Machinist:

I suppose you have read of the Case engine now being made in New Britain, Conn.

Last week I had the pleasure of seeing it in operation, and one thing that attracted my attention was, that when the throttle was closed the engine did not stop until friction was applied to some of the pulleys and brought it on to the center.

There is no condenser or vacuum about this engine, and nothing remarkable about its keeping on turning round after the throttle was closed, only it might be well to put it in the history that is being made at the present time on this subject.

W. E. Crane.

Waterbury, Conn.

There seems to be some difference of opinion among the astronomers as to what results may be expected from the use of the great Lick telescope; but we think there will be but one opinion among mechanics as to the character of the work which is being done by Warner & Swazey, of Cleveland, upon the mammoth machinery by means of which the immense objective is to be made use of. A representative of the American Machinist called upon them a few days ago, and found the work upon the instrument progressing favorably; and it is expected to be completed about the 10th of October. The work being done upon it is of the very highest grade.

American Workmen in Europe.

The London correspondent of the *World*, writing to that paper, says there are large numbers of foolish Americans continually going to Europe to seek work. He says: "The fact cannot be too widely published that Europe is no place for American workingmen of any class. If they come over here with positions secured in advance they still run the risk of being exposed to poverty and distress. And if their places are lost it seems almost impossible for them to get a foothold again. The competition in Europe among the workingmen is so fierce, and wages are so low in comparison with those in our own country, that it is hard to understand how any intelligent American workingman would venture to come here without careful investigation."

An instance is given of an American electrician, who had been connected with the Edison Company in New York, who went to Paris under contract with the Edison Company in Paris, and who, after being there a short time, lost his place on account of the envy and prejudice of his French fellow employes. He went to London, and being unable to find anything to do, was reduced to the most abject poverty and want.

All this should teach American workingmen that while the immense tide of foreign immigration no doubt has a tendency to equalize the condition of labor in this country and Europe, yet such a condition is by no means yet reached, and that we should be very cautious about exchanging a condition which is, perhaps, not all we could desire for one which is undoubtedly much worse.

Hydraulics is defined as that branch of science, or engineering, which treats of fluids in motion—especially of water.

The definition given of the word hydrostatics is: That branch of science which relates to the pressure and equilibrium of non-elastic fluids. * * * * The principles of statics applied to water and other liquids.

The above definitions, taken in connection with the fact that the water in all hydraulic presses is always in motion when the press is in operation, would seem to indicate that the term "hydrostatic press," as used by many builders and writers, is a misnomer, and that the proper term is hydraulic press.

It would seem to be in accordance with the eternal fitness of things that machinists, who deal in exact measurements, calculations, etc., should also make use of exact terms in the naming of their products.

At the recent Manchester Exhibition was shown an arrangement for holding tools in position while being ground, which seems to possess some new features of interest.

The tools to be ground are clamped into a tool holder which is mounted upon two massive arms, swinging to and from the grindstone upon a center situated in the lower part of the frame, motion being imparted to the arms by worms engaging segments of worm wheels bolted to the arms. By this means, sliding surfaces are dispensed with; the use of which about a grindstone is attended with well-known difficulties.

Mr. E. P. Edwards, civil engineer and road master Northern Iowa Division C. & N. W. Railway, has invented a foot-guard which, it is to be hoped, may cause a diminution of that terrible variety of railroad accidents in which the unfortunate yardman is caught by the foot in a frog and held fast until crushed to death.

As it is a cheap device, much cheaper than damage suits and surgeons' services, it may be hoped that it will come into use.

There has recently been constructed at the Krupp works at Essen what is probably the largest crane in the world. It weighs 250 tons, and is capable of lifting 150 tons. It has been erected at the entrance of a new harbor for sailing vessels at Hamburg.

Modern Locomotive Construction.

By J. G. A. Meyer.

FORTY-NINTH PAPER.

FRAME PEDESTALS.

The figures numbered 271 and up to 279 represent the proportions of frame pedestals for passenger locomotives of different sizes.

The function of the pedestal is to hold the axle box—often called the driving box—at a given distance away from the cylinder, but in the meantime allowing the axle box to move in the pedestal in a vertical direction. The pedestals are made of wrought-iron, and each one, as shown in Figs. 271 and 280, consists of a portion of the upper frame brace B, the pedestal legs A, A_2 and the mechanism used for preventing the increase of the opening at the bottom of the jaw. The three parts, namely, the portion of the frame brace B and the two pedestal legs A, A_2 form what is called the pedestal jaw. The pedestal legs in large locomotives are often connected together, as shown in Fig. 271, at the bottom by the bolt D passing through a frame thimble T inserted in the opening of the jaw; in smaller engines the legs are connected by a pedestal cap C as shown in Figs. 277, 278, 279 and 280. The frame thimble T is made of cast-iron, the pedestal cap C is made of wrought-iron. The reason for not using the bolts D and frame thimbles T in smaller locomotives is, that the bolt D will interfere with the wedge bolt E, as will be presently explained.

The pedestals are united in each frame by the upper frame brace B_2 and the lower frame brace L; these braces are forged to the pedestal jaws.

There are two distinct forms of pedestal jaws used; one is represented in Fig. 271 and the other in Fig. 280. The difference between these two forms exists in the shape of one of the pedestal legs, thus: The pedestal represented in Fig. 271 has one straight and one tapered leg; that is to say, the inside of one of the pedestal legs as A_2 (called the straight leg) is planed square with the top of frame, the inside of the other one A, in the same jaw is planed so as to form an angle with the top of frame, making the opening at the bottom of the jaw greater than the width of jaw at the top. In the pedestal represented in Fig. 280 both legs are tapered. The form of pedestal shown in Fig. 280 has been used very extensively in former years; but lately the adoption of the form of pedestal shown in Fig. 271 has increased. Some master mechanics prefer to use for all locomotives the pedestal caps as shown in Figs. 277, 278, and 279 in place of the cast-iron frame thimbles T and the bolts D; but the writer believes that the use of the thimble and bolt will add to the merit of this pedestal, because by the use of the bolt D the lower frame brace L will have to be placed closer to the top of frame, and thereby bringing the lower brace nearer in line with the center of driving axle; by so doing a better distribution of metal in the frame is secured, and the stiffness of the pedestal legs increased.

Wedges.—The function of the wedges—shown in section—and marked W, W_2 in Fig. 271 is two-fold; first, they protect the pedestal legs from wear; secondly, with these wedges is taken up the play between the axle box and the wedges, caused by the wear, which will result from the vertical movement of the axle box. The wedge marked W is called the "short wedge," and the wedge marked W_2 is called the long wedge. It may here be necessary to remark, that although the long wedge W_2 in this pedestal has in nowise a wedge shape, and consequently "a shoe" would be a better name for it, we shall, for the sake of simplicity, retain the term "wedge," as this term will cover the long wedge used in the form of pedestal, as shown in Fig. 280, in which the long wedge W_2 must necessarily have the shape of a wedge, similar to that of the short one. The wedges must be accurately fitted in the pedestal jaw, so that the wearing surfaces $s\,s$ and $s_2\,s_2$ of these two wedges will be exactly parallel to each other, perpendicular to the top of the frame, and the distance between these wearing surfaces equal to the width of the axle box.

Long Wedge.—The long wedge is always fitted to the straight pedestal leg, and since the wearing surface $s_2\,s_2$ (Fig. 271) of the wedge must stand perpendicular to the top of frame, it follows that the thickness of the metal forming the wearing surface $s_2\,s_2$ must be the same throughout. The length of the wedge W_2 is equal to the distance between the top of the thimble T and the bottom of the frame brace B, so that this wedge cannot move in a vertical direction, and it is further secured in position by the screw bolt R_2, which holds the wedge firmly against the straight leg. In order to prevent, on the long wedge, the formation of ridges, the thickness of the metal at the ends is reduced, causing the wearing surface on three sides of the wedge to project beyond the metal at the ends, and these projecting surfaces are accurately planed. The long wedge is shown in detail in the Figs. 281 and 282.

Short Wedge.—The reduction of the metal at the ends of the short wedge W (Fig. 271) is not necessary, because the length of the wedge is always made equal or a little shorter than the length of the axle box, and consequently, ridges cannot be formed on this wedge, as the axle box in its vertical movement will move beyond the ends of the wedge. Since the wearing surface $s\,s$ of this wedge must be perpendicular to the top of frame, and since it has to fit the tapered pedestal leg, it follows that the part of the wedge against which the side of the axle box slides must have a wedge form, as shown. The play between the wedge and the axle box is taken up by moving the short wedge upwards by means of the wedge bolt E. By so doing, the short wedge will slide against the inner surface of the tapered pedestal leg A, and thereby reduce the distance between the wedges. When the short wedge has been moved into the correct position, it is held there by the wedge bolt E, and also by the screw bolt R, which holds the wedge firmly against the pedestal leg. For the bolt R a slot is cut into the leg, so that the bolt can be moved up or down with the wedge to any desired position. The short wedge is shown in detail in Figs. 283 and 284.

Wedge Bolts.—When a cast-iron thimble is used as shown in Fig. 271, two wedge bolts E are employed for each short wedge. These bolts pass through slots $m\,m$, Fig. 273 a, cast into the thimble near the end, one on each side of the bolt D. The reason for casting slots near both ends of the thimble, as shown, is to make the thimble reversible. The heads of the wedge bolts are cylindrical in form, as represented in Fig. 285. These heads fit into recesses $f\,f$ cast into the short wedge, as shown in Fig. 283. In small locomotives the frames are not sufficiently wide to admit two wedge bolts, and therefore only one wedge bolt can be used, and this bolt must be placed in the center of the wedge, as indicated by the recess f in the wedge shown in Fig. 286. But placing the wedge bolt in the center of the wedge will prevent the use of a pedestal bolt D, which must also pass through the center of the pedestal legs, and therefore these two bolts will interfere with each other. It is for this reason that in small locomotives, wrought-iron pedestal caps C, as shown in Fig. 277, are employed in place of the cast-iron thimble T and pedestal bolts D.

In the writer's opinion it is always best not to tap the pedestal caps for the wedge bolts E, but to allow this bolt to pass through a slot cut into the pedestal cap. In this case the wedge bolt will have the same form of head as shown in Fig. 285. If the pedestal cap is tapped for the wedge bolt then the head of this bolt will have a conical form, as shown in Fig. 288.

Proportions of Wedges and Bolts.—We have already stated that the length of the long wedge must be equal to the length of opening in the pedestal; and the length of the short wedge equal to the length of the axle box, or a little shorter. In the long wedge

the thickness of the metal which forms the wearing surface s_2 s_2 should not be less than that given in the illustrations; and the thinnest part of the wedge form in the short wedges should be about $\frac{1}{2}$ of an inch for small locomotives and $\frac{5}{8}$ of an inch for large locomotives. The flanges of all the wedges in small locomotives should not be less than $\frac{5}{8}$ of an inch and $1\frac{1}{16}$ inch for the larger locomotives; the exact thickness of these flanges for the different sizes of axle boxes, and which the writer would recommend will be given in other illustrations. The diameter of the wedge bolts *E* is usually $\frac{3}{4}$ of an inch for the small locomotives, and $\frac{7}{8}$ of an inch for larger ones. The bolts which hold the wedges to the pedestal legs are generally made $\frac{3}{4}$ of an inch in diameter.

All the principal dimensions of the pedestals for passenger locomotives are given in our illustration, and these dimensions agree with modern locomotive practice. In connection with this subject it may here be remarked that in late years the mechanism of the larger locomotives have been made heavier and the weights of these locomotives increased. It will, therefore, be found by comparison that the dimensions of the larger pedestals will exceed the dimensions of pedestals made a few years ago, and the dimensions given for the smaller pedestals will agree very closely with the dimensions of the average pedestals now in use. The dotted circle with the size of diameter given in each pedestal represents the driving axle journal suitable for each one of these pedestals. It will be noticed that the diameter of the journal given in Fig. 271 is considerably larger than the average diameter of journals used in passenger locomotives built some years ago; but in modern engines of this class and size, axles as large as shown in this figure are now used, and the writer believes it is only a matter of time when this size of axle will be generally adopted for fast passenger engines having cylinders 18 inches in diameter. More on this subject will be given in our next paper.

M. Emile Trelat has reported on behalf of the French sub-commission on fires in theaters, strongly in favor of the use of chemicals rendering the stage and all its contents uninflammable, stating that the expense will not be so great as is imagined, and should fall on theater geors, who cannot grudge an extra charge for safety.

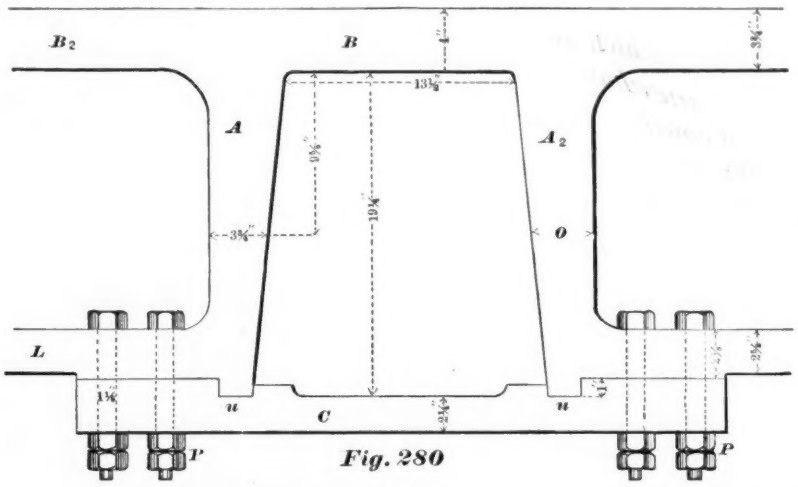


Fig. 280

Fig. 281

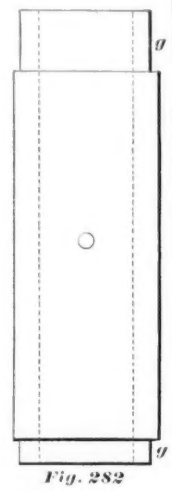


Fig. 282

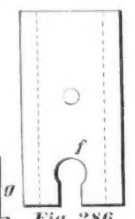


Fig. 286

Fig. 287

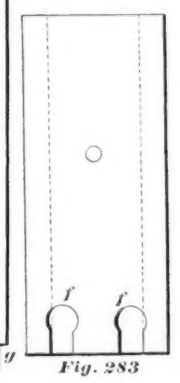


Fig. 283

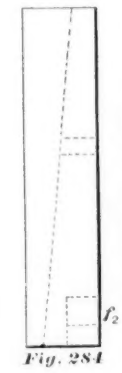


Fig. 284

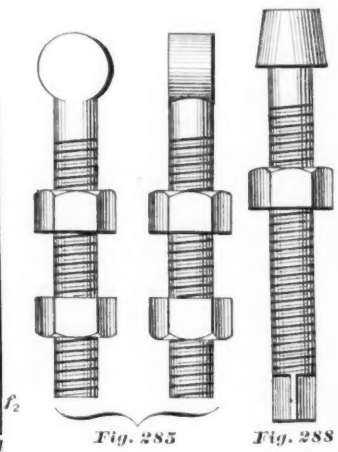


Fig. 285

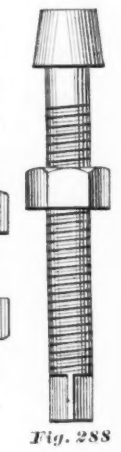


Fig. 288

18″ Cyl. Frame 4″ wide

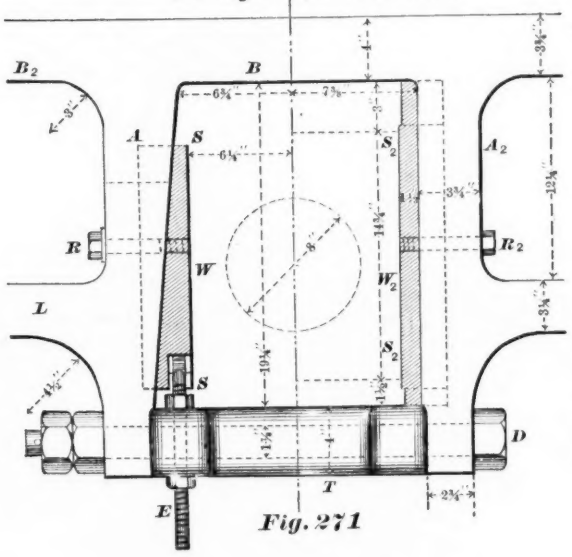


Fig. 271

17″ Cyl. Frame 4″ wide

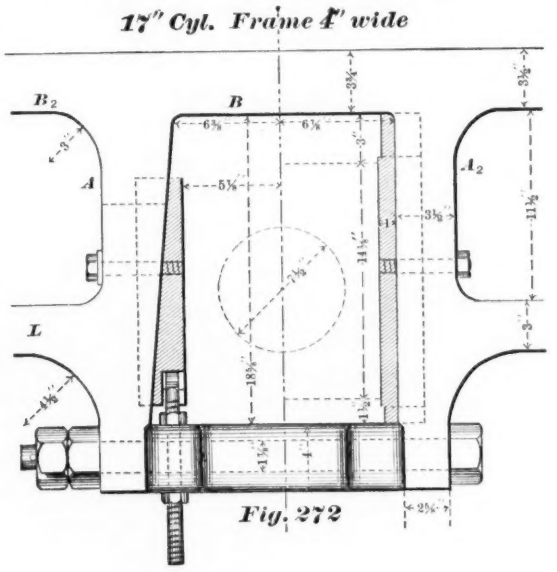


Fig. 272

16″ Cyl. Frame 4″ wide

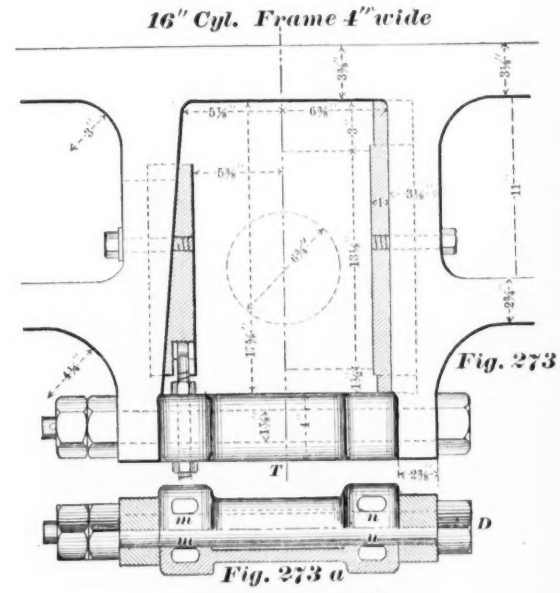


Fig. 273

Fig. 273 a

15″ Cyl. Frame $3\frac{3}{4}$″ wide

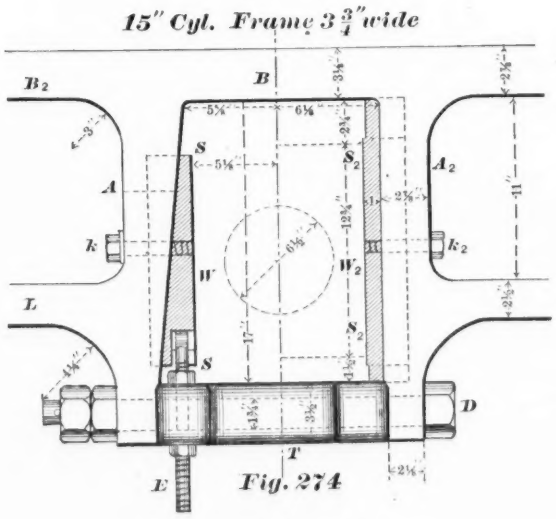


Fig. 274

14″ Cyl. Frame $3\frac{3}{4}$″ wide

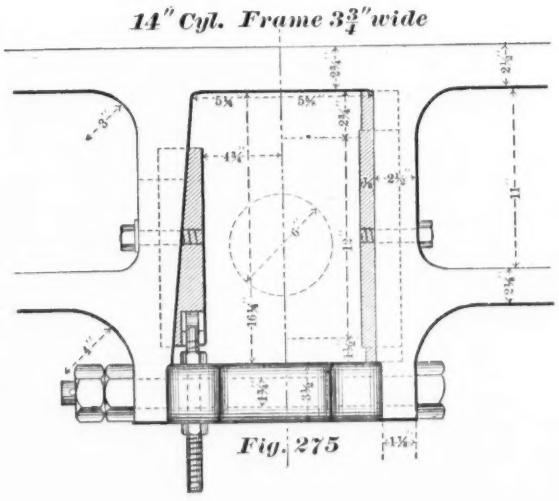


Fig. 275

13″ Cyl. Frame $3\frac{3}{4}$″ wide

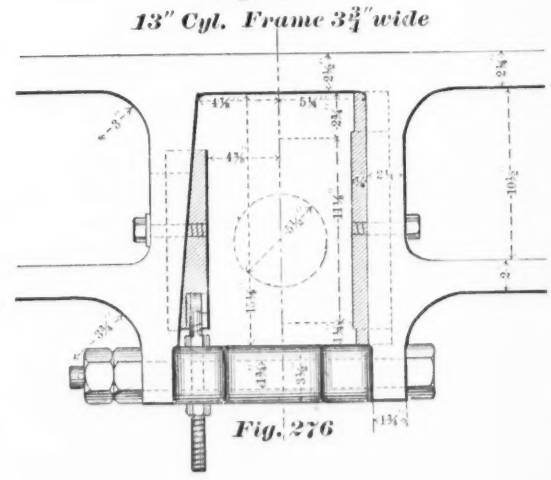


Fig. 276

12″ Cyl. Frame $3\frac{1}{4}$″ wide

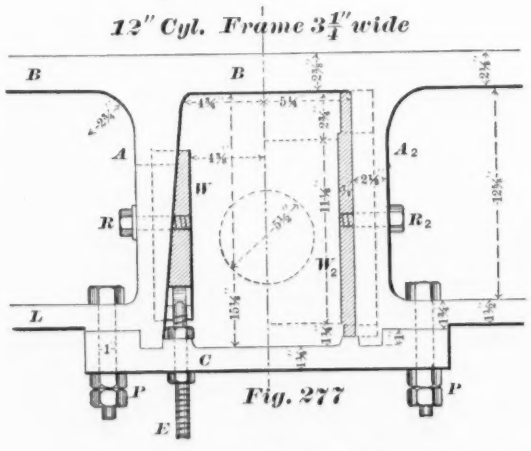


Fig. 277

11″ Cyl. Frame 3″ wide

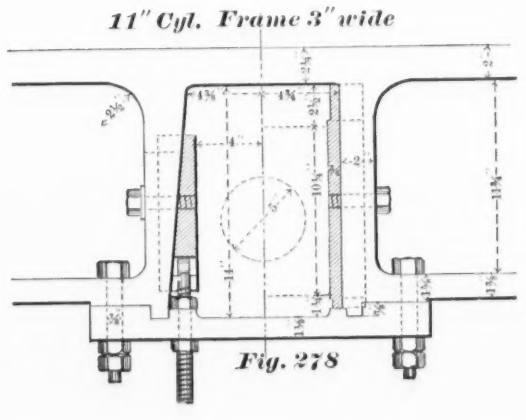


Fig. 278

10″ Cyl. Frame 3″ wide

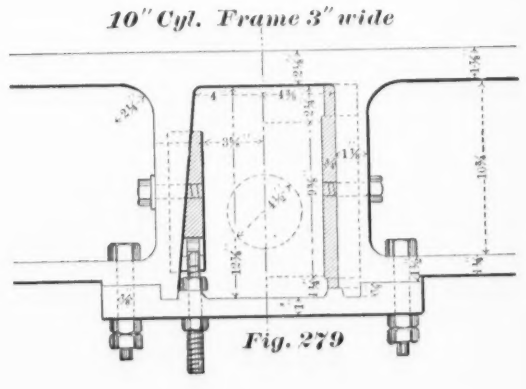


Fig. 279

Frame Pedestals, Designed for Four-Wheel-Connected Locomotive Engines, for Passenger Service.

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NEW YORK, OCTOBER 15, 1887.

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Our Naval Reserve.

The United States Government is making an effort to organize a naval reserve from the merchant marine. The plan is an excellent one, but there is a difficulty in the way of any very important results. The merchant marine of the country does not afford a large field from which to select. It is getting nearer and nearer to a negative quantity every year. The United States has set itself for years persistently against doing anything in the way of encouragement to shipowners or shipbuilders. Every other nation of commercial importance pursues the opposite course. This course would enable England, for instance, to enormously add to her navy in the case of war or rumors of war, and would be equivalent to a large money consideration. So long as the policy of encouraging shipbuilding is maintained in other countries and discouraged here, the Secretary of the Navy will never be burdened by vessels from which to select an auxiliary navy.

That no encouragement should be extended to shipowners and shipbuilders may be right enough in theory, but it does not work well in practice. The matter is not, unfortunately perhaps, one of sentiment; it is a matter of trade, and of dollars and cents. The people are, very properly, zealous in promoting and protecting manufacture; just now one of the best ways to do this is to provide for carrying more of our manufactured goods to those who want them, in vessels flying the American flag. In fact, there is no other way of very materially increasing export of manufactured goods but this, and manufacturers are as much interested in doing this as shipbuilders and shipowners. Mechanics and workmen are interested in it no less than agriculturists. To the former it means more work, to the latter better markets for the products of their farms. There is no single measure that would benefit so large a proportion of the population of the country as one that would judiciously assist in increasing the merchant marine. If the lawmakers are wise it will not be many years before the Secretary of the Navy will not be hampered, as he now is, in forming a naval reserve. We want to build the vessels, we want to equip them, and we want the foreign trade that would result from an increase of the merchant marine. We want this in the interest of the shipbuilder and shipowner, in the interest of the artisan and manufacturer, and in the interest of the farmer.

Importance of New York State Canals.

Materially more business has been done this year on the canals in the State of New York than was done last year. Every year the growing importance of the navigable waterways of the country—artificial and natural—is demonstrated. Anything that tends to check their usefulness is a direct blow at the interests of the people, because the advantages for transportation which they afford belong to the people, and can never be controlled by monopoly. The canals of New York, in connection with the Hudson River, save the people many thousand dollars every year in the way of freight charges, besides affording poor men an opportunity to engage in one of the most important affairs of the country, viz., transportation, in competition with the richest corporations. A man with just means enough to own a canal boat may and does become a competitor of the railroads, and one by no means insignificant. In these times of concentration of capital, the prospects of men of small means successfully engaging in business are not great; the canals afford one that ought to be jealously guarded.

The standing argument of those largely interested in railroads is that freight can be carried cheaper by rail than by water. If this is true, then there should be no objections on their part to canals. The fact that there is this year an important increase in the tonnage passing through the canals does not, it is true, prove that railroads cannot carry freight cheaper than it can be carried by water, but it is about the best possible evidence that they will not.

Work and Study.

One of the very best habits which any young man entering upon a mechanical career can contract is the habit of continually consulting authorities upon any and every subject which presents itself in connection with his work. Many of the ablest mechanicians of the country owe their success to this habit faithfully followed. To take a survey of all the range of knowledge necessary to be covered by one who aspires to rise in the profession, is discouraging enough to him who stands upon the threshold and has everything yet before him. But let him remember that there is a time for everything, and that no true student of science ever becomes satisfied with his attainments in the field of knowledge, ever gets through being a student; that no man knows it all; and that those who know the most are the last to claim complete knowledge. Let the young mechanic therefore patiently and thoroughly investigate each subject as it presents itself to him, consulting authorities, making original experiments when possible, and leaving no subject until it shall have been as thoroughly explored as it is possible for him to explore it, making a note of such points in connection with each subject as he is unable to satisfy himself upon, to be further investigated in the future when better facilities are available, or his own capacity for absorbing knowledge has increased, as it surely will.

This course faithfully pursued, will, in its results, be a surprise and a gratification to him who follows it; and instead of being burdensome will in most cases become a continued enjoyment and pleasure, and in the end—though this should be a minor consideration—profitable.

No one who has a true love of mechanics will be satisfied to spend his life turning shafting, and boring cylinders, and cutting gears, without at least making an honest effort to understand the principles upon which such things are proportioned, and by which they accomplish the purpose for which they are designed.

For the young mechanic, who, when his hours of labor are ended, and his supper eaten, habitually goes out "among the boys" to the saloons, and worse places, to spend his evenings, whose library consists of yellow-backed novels, and his newspapers the police news—there is a career mapped out which is almost certain to end in disappointment, if not disgrace, while for him who takes the other road—the one indicated above—there awaits honor and success.

The habit of study—of mastering things as they come up—can be as firmly fixed as the habit of loafing; and it should always be remembered that it is as much the ability to acquire knowledge of any given subject, when occasion demands, as the possession of knowledge *per se*, which distinguishes the successful engineer.

The latest trial of the dynamite gun at Fort Hamilton is significant. To be sure, a mile and a quarter is not a great distance to throw a shell, and blowing up an old hulk of a schooner is not a very important event. But, on the other hand, the rifled cannon of the present day was not the work of a year or two, and it is quite fair to assume that the dynamite gun of the near future will show as great advances over the present one as steel rifled guns show over the old smooth-bore cast-iron gun. It appears to us that the trial referred to was a very satisfactory one, indeed, in that it points to the possibility of making the dynamite gun one of the most valuable engines of defense.

Several years last past have not been good ones for mechanics' fairs, and this year is not likely to be any better. Interest in such exhibitions has gradually died out, and a purely mechanical exhibition stands little chance of attracting paying audiences. Annexed to an exhibition mainly of other things, a show of machines and machinery may be a good feature, but alone it is not sufficient, however good. This change in sentiment is undoubtedly due to the fact that other means of showing up machines have supplanted the fair, and the practice of dealers in keeping large supplies on hand makes it possible to see more purely mechanical things in stores in any large city where fairs are likely to be held than it is possible to get together at a fair. Then the practice of manufacturers in this country, of permitting inspection of their works and products, robs fairs of much of the interest they have in such countries as England. The day of mechanics' fairs appears to have passed.

The Brotherhood of Locomotive Firemen of New York held their sixth annual reunion and festival at Lion Park, Sept. 16. It was an affair in every way enjoyable, rendered more so by the presentation of a gold medal to Treasurer McDermott, for faithful services. The Brotherhood of Locomotive Firemen is one of the most prosperous and praiseworthy organizations of the kind in the country; everybody is glad to hear of its prosperity.

Germany appears to be the country most feared by England in the way of competition in manufacture. If it is true, as commonly reported, that in order to make competition successful Sunday work in factories is fast coming to be the rule in Germany, then we should say that German competition would be a temporary matter. A nation whose workmen work seven days in the week will very soon cease going up in the scale.

Barbed wire fencing has received a setback in Pennsylvania. By a recent decision of the courts no line fences can be made of barbed wire without the consent of the adjacent owner, and if such fences are used along the highways those who build them are liable for all damage to stock passing along the highway.

Literary Notes.

MANUAL OF THE RAILROADS OF THE UNITED STATES FOR 1887. By Henry V. Poor. Twentieth Annual Number. New York: H. V. & H. W. Poor, 70 Wall street. Price, $5.

Those who are specially interested in railroads look with an increasing interest every year for the appearance of this standard work. It is the only work that gives complete statistics of the railroads in the country, and its compilation shows an amount of work almost incredible. The present number contains over 1,000 large and closely printed pages, showing the route, mileage, stock, bonds, debts, cost, traffic, earnings, expenses and dividends of all railroads, together with their organizations, directors, officers, etc.

A TREATISE UPON CABLE OR ROPE TRACTION as Applied to the Working of Street and other Railways. (Revised and enlarged from *Engineering*.) By J. Bucknall Smith, C. E. Published by John Wiley & Sons, 15 Astor Place New York.

We believe this work will be valued and highly appreciated by engineers engaged in designing cable or rope traction, as applied to street and other railways, and by persons generally interested in this subject. In this age of progress, in which quick and economical transportation has engrossed the study and attention of many able engineers, and has been eagerly sought for by the public in general, the publication of this book seems to us to be most timely. The subject is ably handled by an experienced engineer. The chief object of this volume is to describe the application and development of a comparatively novel system of mechanical traction for street and other railways, known as the "endless cable haulage system." This system was first introduced for working street railways in San Francisco, where it has since achieved a marked mechanical and financial success. It is not

the intention of the writer to advocate an universal application of system, and any comparisons with other existing means of traction are wholly impartial, and made with the object of placing before the reader the relative merits of the system at issue. The treatise is divided into seven sections or chapters, in which the subject of cable and rope traction is taken up in the following order:

1. Preliminary remarks upon cable or rope traction schemes relating to mining and railway rope haulage.
2. The history and development of street cable railways proper, including descriptions of the principal feature of construction and operation of street cable railways in the city of San Francisco, Cal.
3. The conversion of the Chicago horse lines to the cable system.
4. The introduction and development of the cable system in New Zealand.
5. Description and illustration explaining the construction and operation of the first cable line in Europe; and the introduction of the system in Australia, etc.
6. Technical examinations of the system, with its costs of construction and working, etc.
7. Financial analyses concerning the system, with remarks, etc.

The book is fully and clearly illustrated, contains 188 pages, and the price is $2.50.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(413) J. M., St. Paul, Minn., asks: Which is the best way to cut steep threads, such as are used in screw-drivers, etc.—one thread in 2"? *A.*—Such threads are not usually cut at all; but if we were to cut them, we should prefer some form of milling machine adapted to the purpose.

(414) O. P. V., Marysville, Mont., asks: How much pressure is required to drive a 2" punch through a ⅞" plate of iron? *A.*—Haswell's rule is: Multiply the product of the diameter of the punch and the thickness of the metal by 150,000 if for wrought-iron, by 128,000 if for brass, and by 96,000 if for copper. According to this rule, the pressure would be 2"×.875"×150,000=262,500 lbs.

(415) J. R., Charleston, S. C., asks: Is there a machine made for making horse and mule shoes, and if so, where can I get one? *A.*—We do not know that such machines are made for sale. So far as we know, when such machines have been invented, the invention has been in the interest of some iron company, which has simply used the machine to make shoes.

(416) J. S, Gravesend, N. Y., asks: 1. I have a steam-starting valve which leaks around the seat. What shall I do to make it steam-tight? *A.*—Grind the valve on its seat. 2. In order to obtain a license for a stationary engineer, will it make any difference if the person applying for it acquired his knowledge from books or from practice? *A.*—If he has the requisite knowledge, it does not make any difference how he obtained it, but we do not exactly see how you are going to get the requisite knowledge without the study of books and also actual practice.

(417) G. S., New York, asks: Are there works published from which I can learn to be a practical steam engineer, and if so, where can I procure them? *A.*—Your question is a very common one, and one you can answer for yourself by a very little reflection. Could you learn to row a boat or to write a good hand by reading how some one else did these things? You will never become a practical *anything* except by practice. You can find books, for which we advise you to visit bookstores dealing in such works, that will be of great help to you, but you must learn the business by working at it.

(418) L., St. Stephen, N. B., writes: My friend and I differ in opinion in regard to the slide valve. He says decreasing the surface of a slide valve does not decrease the friction. My argument is, that if you decrease the surface you decrease the friction in the same proportion. You will have the same friction on the same number of square inches; but as you have less square inches, I claim you will have less friction? Which is right? *A.*—Neither you nor your friend are right. Diminishing the surface of a slide valve does diminish the friction, but not necessarily in proportion to the decreased surface. This proportion will depend upon the proportion of the actual bearing surface to the total area covered by the valve, and is also dependent upon the absolute pressure in the steam chest, and the condition of the bearing surfaces. For a full explanation, we refer you to Prof. Robinson's paper on this subject, published in the American Machinist of June 2d, 1883.

(419) E. I., Lincoln, Ill., writes: Please give me a receipt for galvanizing cast-iron. *A.*—Cleanse the articles in an ordinary chafing mill, which consists of a barrel revolving on its axis and containing sand; when the sand is all removed, take them out and heat one by one, plunging while hot in a liquid composed as follows: Ten pounds hydrochloric acid, and sufficient sheet zinc to make a saturated solution. In making this solution, when the evolution of gas has ceased, add muriate, or preferably sulphate of ammonia, one pound, and let it stand until dissolved. The castings should be so hot that when dipped into this solution, and instantly removed, they will immediately dry, leaving the surface crystallized like frostwork on a window pane. Next plunge them while hot, but perfectly dry, into a bath of melted zinc, previously skimming the oxide on the surface away, and throwing thereon a small amount of powdered sal-ammoniac. If the articles are very small, enclose them in a wrought-iron basket on a pole, and lower them into the metal. When this is done, shake off the superfluous metal, and cast them into a vessel of water to prevent them from adhering when the zinc solidifies.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Adv., page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Air Compressors, Rock Drills. J. Clayton, 43 Deyst., N. Y

Exhaust Tumbl'g Bbls. Henderson B's., Waterb'y, Ct.

Upright Drills from 20" to 36" inclusive. Currier & Snyder, Worcester, Mass.

For Improved Cooper Stoves, send to Variety Machine Co., Warsaw, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Quints' Pat. Auto. Steam Engine Governor. Correspondence solicited from mfrs. of Throttle Gov'nr Engines. Leonard & McCoy, 118 Liberty st., N. Y.

Nicholson & Waterman, Fine Engine Lathes, Nicholson & Waterman, Boring Mills. Nicholson & Waterman, Providence, R. I., Bolt Machinery.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Oct. 8, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N. Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 18th st., N. Y. Send for des'n.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

Engineer's Hand Books, post-paid anywhere. Roper's, $3.50; Haswell, $4; Reed's, $4.50; Trautwine, $5. Circulars free. Theo. Audel & Co., 91 Liberty st., N. Y.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the American Machinist. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Pub'g Co., 96 Fulton st., New York.

Manufactures

Valuable beds of niter have been discovered in Eureka county, Nev.

M. O. Arnold is interested in building a paper mill at Talladega, Ala.

The Texarkana Northern Railroad will build repair shops at Texarkana, Ark.

The New Haven (Conn.) Folding Chair Company are building a factory in that city.

The Sheffield Agricultural and Machine Works are erecting shops at Sheffield, Ala.

The Ensign Manufacturing Company are enlarging their works at Huntington, W. Va.

A company, under the title of the Alabama Brewing Company, will build a brewery at Montgomery, Ala.

The citizens of Grafton, Mass., are moving, through public meetings, to establish an electric light plant.

A company, known as the Bessemer Electric Light and Power Company, has been chartered at Bessemer, Ala.

A large bed of iron ore, said to be of excellent quality, has been discovered in the western portion of Gregg county, Tex.

William T. Cotter, Sanford, Ark., will enlarge his planing mill, putting in new machinery, including engine and boiler.

The Southern Pacific Railroad shops at Sacramento, Cal., at present employ 2,000 men, but will soon increase their force.

Carson City, Mich., has voted for $10,000 worth of improvements, in the form of water-works and manufacturing enterprises.

T. R. Bonner & Co., Lufkin, Tex., will increase the capacity of their saw mill, and will put in planing and other machinery.

The Daley Manufacturing Company is the name of a new concern which will manufacture agricultural implements at De Kalb, Ill.

Jacob Lorillard's brick works at Keyport, N. J., the largest in the United States, were destroyed by fire recently. The loss is $500,000.

A part of the shops of the C. H. & D. R.R., at Lima, Ohio, were recently destroyed by a fire, which originated in the wood-working department.

The extensive building of the Minneapolis, Sault Ste. Marie and Atlantic Railroad, at Gladstone, Mich., has been commenced, and will be completed before snow flies.

The wood-working establishment of H. B. Clark & Co., at Wayland, Mich., was destroyed by fire recently. It will probably be rebuilt, as the enterprising citizens are proffering assistance.

The Southern Pacific Company has received, or has now on the way, 55,000 tons of rails, manufactured in England, which are to be used in extensive developments of that system in California.

The sum of $1,300,000 is set apart for new engines and cars by the Pennsylvania Railroad Company. Sixty new engines are to be built at once and 150 passenger coaches. Since January 1st over 11,000 freight cars have been added to the equipment.

The Farmers' Alliance, of Southwest Texas, have purchased the woolen mill of New Braunfels. It is the intention of the alliance to start the mill, which has been closed for some time, as soon as the necessary machinery for it can be purchased.

The Cheraw Iron Works is the name of a company at Cheraw, S. C., which proposes to engage in the foundry business and the manufacture and repairing machinery. The capital stock is put at $20,000, divided into 400 shares of the par value of $50 each.

The Frazer Axle Grease Factory, recently burned at Jersey City, N. J., will be rebuilt without delay, but the company has decided upon improvements which will make a fire almost impossible, and thus remove the objections of the people living in the neighborhood of that place.

Keufel & Esser, New York, have issued a catalogue of nearly 300 pages, fully illustrated, descriptive of drawing tools and materials and surveyors' instruments. The catalogue—twentieth edition—which is very complete, contains full directions for ordering goods by number and letter.

Cheney Brothers, at South Manchester, Conn., are putting up a mill 325 feet long by 60 feet wide and three stories high, which will probably be used for the production of velvets. The silk factories at New London, Conn., and Holyoke, Mass., and elsewhere, are busy, and from time to time increase their capacity. At Oakland, R. I., a silk mill has just been started.

J. H. Cooke, of Miller's Falls, Mass., and Geo. A. Dinsmore, of Brattleboro, Vt., have leased the shop and tools of the Gilkerson Machine Works at Homer, N. Y., and will carry on business there, retaining the name of the works. They will continue to make planer vises, and, in fact, all the specialties heretofore made at the works, and in addition will make many other specialties, for the manufacture of which they will add new machinery. They start with good prospects of success.

The Muskegon (Mich.) *Chronicle* says: "Dr. J. M. Cook, of this city, Dr. Vander Veen, of Grand Haven, and a Grand Haven lumberman have formed a company under the firm-name of Cook, Vander Veen & Co., for the purpose of conducting lumbering operations in Wisconsin. They last week purchased of Monroe, Boyce & Co. the saw and Shingle mill at Spring Lake, and will at once remove the entire plant to Sturgeon Bay, Wis. There they have purchased a mill and excellent site, several residences, boarding houses, etc., included, of Spear & Co.

A. E. Sumner, for the past three years secretary to President Newell, of the Lake Shore, has resigned his position to enter into business with John S. Davis, formerly of Toledo, and A. H. Johnson, president of the Arkansas Midland Railway. The firm will manufacture harvesting machinery, and is about to erect a plant at Cleveland, Ohio, near the junction of Lorain street and the Lake Shore tracks, having secured ten acres of land in that vicinity. They will transact business under the name of the Davis Platform Binder Company. Mr. Sumner will be general manager of the business.

The new steam plant at the U. S. Mint, Philadelphia, has been completed, tested and accepted by the Government. The plant consists of three Galloway boilers, furnished by the Edgemoor Iron Company, Wilmington, Del.; three Buckeye automatic engines, built and furnished by the Kensington Engine Works, Limited, Philadelphia, Pa.; one 400 horse-power Kensington patent straight through tubular feed-water heater, built by the Kensington Engine Works, Limited; new and complete system of shafting, furnished by William Sellers & Co., Philadelphia. Wilson Bros. & Co. were the Government engineers. The work was done under the direction of Hon. Daniel M. Fox, superintendent of the Mint. The entire plant is a very complete and carefully-planned piece of work, and reflects great credit on all concerned.

Newton Linsley, Freeport, Ill., writes us: "This city is having a boom. The citizens bought out and donated the old malleable shops to the Madison and Northern Railroad, to be used for construction shops, employing about 125 men at first. The Illinois Central is building a 25-stall round house. Emery & Keene built a canning factory this summer, and have done a good business. The Storer Manufacturing Company are putting in a large plant for fine gray iron castings—foundry, 60x250 feet; rattling and grinding room, 37x80 feet; pattern room, 37x80 feet; two stories high; will employ 100 men, and have orders for 500 tons already booked, and could have had as much more if buildings had been ready. The Warner Manufacturing Company have lately enlarged their works; they run on hardware."

Water-works, new or extensions, are being agitated at Fentonville, Mich.; Washington, Ga.; Ness City, Kan.; Tuscola, Ill.; Marinette, Wis.; Winchester, Ky.; Weatherford, Tex.; Greeley, Col.; Gaylord, Mich.; Lyons, Ill.; Templeton, Cal.; Norfolk, Neb.; Bellevue, Mich.; Tazewell Court-House, Va.; Worcester, N. Y., contract let to Francis Leonard; Albany, Ga., by Jeter & Broadman; Salisbury, Md., by J. A. Cloud; Saugus, Mass., by Goodhue & Birnie; Morrisonville, Ill.; Milford, Del.; Akron, Cal.; Manitowoc, Wis.; Clarkville, Tenn.; Lostant, Ill.; Pontiac, Mich.; Seymour, Ind.; Stromsburg, Neb; Rushville, Neb.; Sheffield, Ala.; Fostoria, Ohio; Bonham, Tex.; Jackson, Miss.; Albion, Mich.; Mennstique, Mich.

The Hewes & Phillips Iron Works, Newark, N. J., are driven with orders for their Corliss engines. While they are building a number of simple engines, their business in compound engines is receiving a large share of their attention. They are building several compound engines for Eastern factories. Amongst other orders for compound engines, is one for two tandem compounds, for the Goodyear Metallic Rubber Shoe Company, of Naugatuck, Conn.; a pair for the Merrick Thread Company, of Holyoke, Mass.; a pair for the Willimantic Linen Company, of Willimantic, Conn.; and one for the new electric light plant of the Thomson-Houston Company in New York city. The Hewes & Phillips Company are also doing a good business in building the Manning boiler in large sizes, for 125 to 175 lbs. steam pressure. They are supplying this boiler largely with their compound engines.

A syndicate of Philadelphians is endeavoring to secure a controlling interest in the Northern Liberties Gas Works, for the purpose of introducing fuel gas for manufacturing purposes in the territory served by the company. Lawyer John Roberts is acting for the members of the syndicate, but that gentleman declines to reveal the identity of his clients in this matter, but it is believed that Hamilton Disston is a leading spirit. Mr. Roberts, however, states that "the object of the syndicate is to supply a fuel to take the place of coal. We have been experimenting for the last nine months, and have finally succeeded in discovering a method of making gas that will do for the East what natural gas is doing for Pittsburgh and vicinity. This method is now in operation at the saw works of Henry Disston & Sons, at Tacony, and gives the greatest satisfaction, saving over 50 per cent. in the price of fuel. Our object is to make the Northern Liberties a manufacturing district, by furnishing a fuel to mills, foundries and factories at one-half the price of coal. The gas is made from the refuse of coal mines, which can be had for the hauling. A ton of this refuse will yield from 60,000 to 75,000 feet of fuel gas. If we fail in securing these works, we will select another locality, and begin the manufacture of gas. It will be but a short time until we find customers for our products."—*Philadelphia Record.*

The citizens of Milo, Me., have subscribed 2,000 for the purchase of the water-power privilege and land belonging therewith, known as the old woolen mill site, the property to be given to any manufacturing company with a capital of not less than $50,000, who may occupy the same. It is expected that such a concern will be exempted from taxation for a term of years.

Machinists' Supplies and Iron.

NEW YORK, Sept. 29, 1887.

Iron—The business transacted in American pig since our last report has revealed no change in the general condition of trade. The offerings are fully equal to, if not in excess of, the demand.

We quote standard Lehigh brands of No 1 X Foundry, $21 to $21.50, according to quantity. No. 2 X Foundry, $19 to $19.50, and Grey Forge, $17 to $17.50, with ordinary brands offered at $15 50 to $16.

Scotch Pig—We quote Coltness, $22.75 to $23; Glengarnock, $21.25 to $21.75; Gartsherrie, $21.25 to $21.75; Summerlee, $22.25 to $22.75; Eglinton, $20.50; Langloan, $21 to $21.50; Dalmellington, $20.50 to $21; and Clyde, $20.75.

Lead—Spot lead is very scarce, but futures—*i. e.*, October—are offered more freely. The nominal quotations are 4.15c. to 4.20c.

Antimony—We quote Hallett's brand, 8¾c., and Cookson's, 9c.

Copper—Spot and September held at 10½c.; casting brands quoted 9⅞c. to 10c.

Spelter—Domestic, 4.50c. to 4.70c.; refined, 5¾c. to 6c.; and Silesian, 4.85c. to 4.95c.

Tin—Jobbing lots Banca, 23½c. to 23¾c.; Straits and Malacca, 23 50c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Supt. machine works wishes to change soon: records and best references given. R. R., AM MACH.

Situation wanted by an experienced pattern-maker foreman; best references. Box 62, AM. MACH.

Situation wanted in the city by a first-class machinist and tool maker. Inquire P. O. Box 3095, N. Y. city.

Machinist wanted; must be first-class on general work, and capable of managing a small shop. J. H. Wells, Tampa, Fla.

Mechanical engineer and first class draftsman, used to designing, detailing, record drawing, etc., wants situation. Address E. B. AM. MACHINIST.

Wanted—Situation as foreman of mach. shop; 20 years' experience; sober; familiar with shop accounts; best references. Box 61, AM. MACHINIST.

Wanted—An experienced foundry foreman for a shop doing hardware and light work. Address, stating age, experience, etc., S. C. E., AM. MACH

Wanted—Situation as foundry foreman; good references; 25 years' experience in loam, dry and green sand; marine work preferred. Address K., AM. MACHINIST.

A mechanical draftsman of long experience in general and special machine design, desires a position; can furnish best references as to abilities. Address Box 58, AM. MACHINIST.

Situation wanted as assistant draftsman, or as machinist, by a young man aged 26, college graduate; 6 years as machinist in different shops; 4 years in this country. V. H., 564 Third ave., N. Y. city.

A practical mech. engineer and draftsman, age 24, with experience in all general machinery, is open for engagement, and can furnish A 1 references; is rapid and accurate. Address P., AM. MACHINIST.

Wanted—By technical school graduate, who is practical machinist, with several years' experience designing, building and improving special machinery, a responsible position, not drafting. Practical, AM. MACHINIST.

Wanted—The position of negotiator or selling agent for a good house or factory, by a mechanical engineer having a large business acquaintance and long experience in that line; answers treated confidentially. Address Mac, AM. MACHINIST.

Wanted—An energetic practical machinist, with five to ten thousand dollars cash, to take charge of an old-established factory, and make printing presses by contract. Address, with reference, age and experience, "Job Press," care AM. MACHINIST.

A young man with good mechanical education and some capital would join some responsible party with practical experience and a little capital in the machine or foundry business; best of references in regard to character, etc., given and required. Address Meteor, care AM. MACHINIST.

Wanted—A foreman for the machine shop of a corporation; must be a first-class mechanic, and whose habits and character are unquestionable; one who is conversant with cotton or woolen machinery preferred; must furnish proper testimonials. Address, stating age and salary expected, P. O. Box 3062, Boston, Mass.

Wanted—An active and practical man to solicit orders and make contracts for a moderate-size establishment building stationary engines, pulleys, shafting, etc., and doing a general foundry and machine business, and dealing in machinists' supplies; must be posted on market prices and discounts; state age, references, experience, and salary expected, which must be moderate, as it is an experiment. Address Traveling Man, care AM. MACHINIST.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner is king, and has no rival. Crescent Mfg. Co., Cleveland, Ohio.

Crescent grease cup for shafting beats them all Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Stationary boat engines, boilers, best, cheapest. 1 to 10 H. P. Washburn Engine Co., Medina, Ohio.

For sale, very cheap, a Roper hot-air engine, three horse-power, in first-class order. Hanzsche & Co., Baltimore, Md.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. I. A. Weston & Co., Syracuse, N. Y.

For Sale—By the Southwark Foundry and Machine Co., Philadelphia, Pa., one slotter, 89" between housings, 24" stroke, movements universal.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer, late chf. draftsman at H. R. Worthington; mechanical and patent drawings; patents of natural gas and water meters for sale.

Wanted, in good order and condition, one 40 in. × 40 in. or 42 in. × 42 in. iron planer, with short bed; one boring mill to bore cylinders up to about 30 in. diameter. National Iron and Brass Works, Dubuque, Iowa.

If you are troubled with scale in your boiler, whether from lime, sulphur, iron, salt or other mineral or corrosive water, send for circular of Petroleum Resolvent, adopted on one hundred railroads. Contains neither alkali or acid, and costs but ten cents a week for the largest locomotive boiler. Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

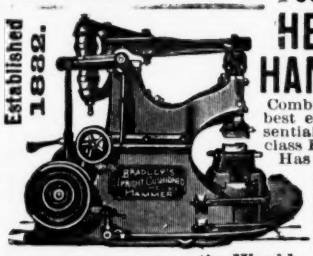
BRADLEY'S HEATING FORGES.

ESTABLISHED 1882.

For Hard Coal or Coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1882.



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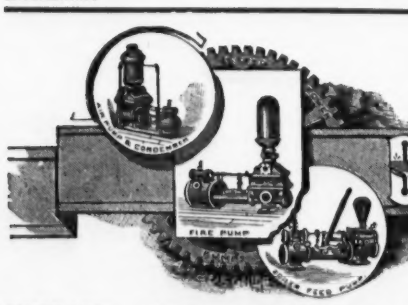

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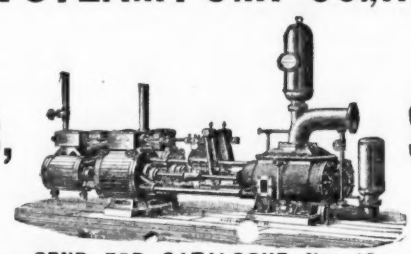

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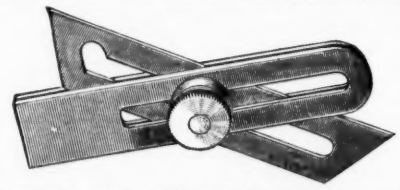

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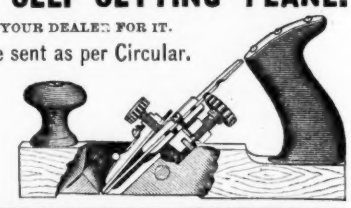

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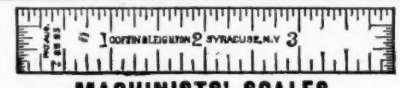

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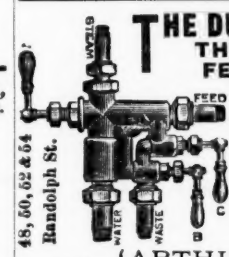

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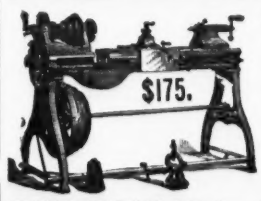

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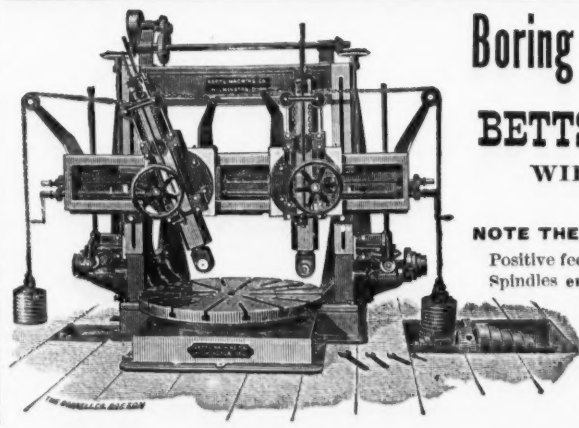

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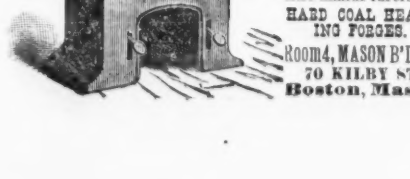

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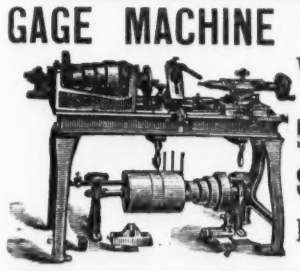

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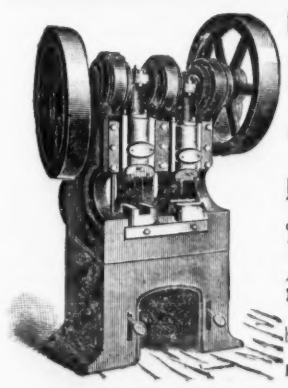

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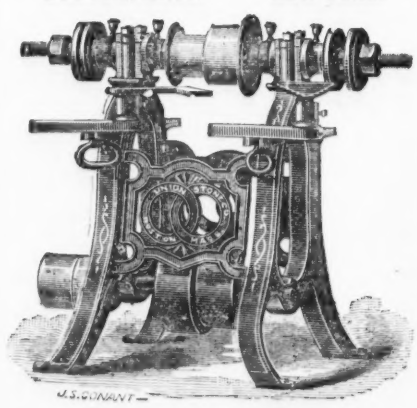

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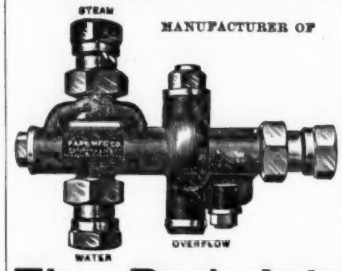

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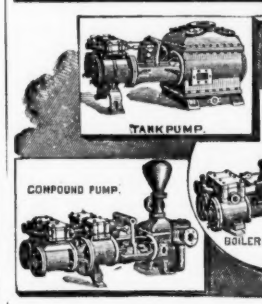

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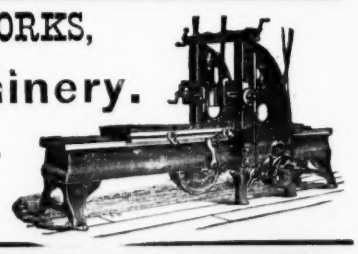

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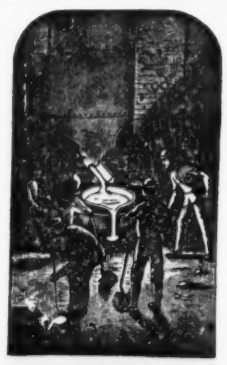

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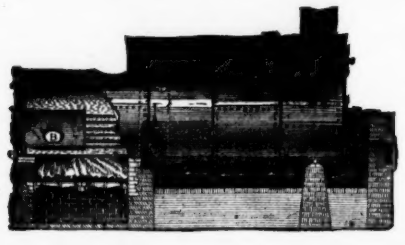

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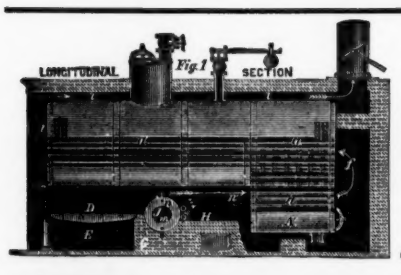

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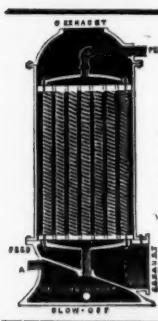

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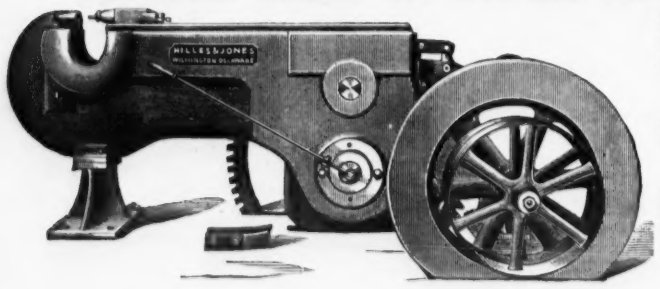

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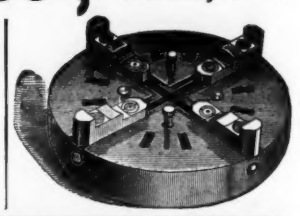

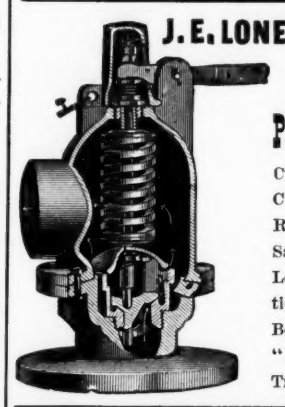

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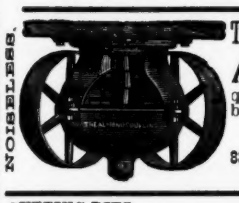

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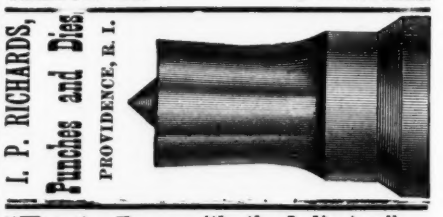

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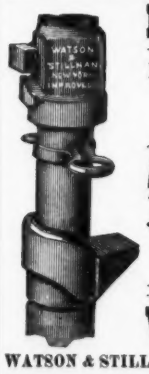

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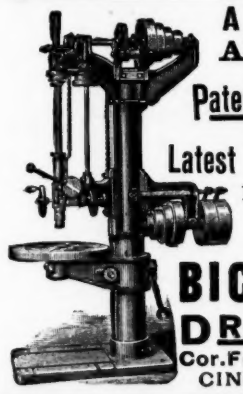

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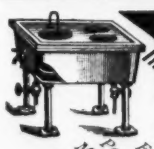

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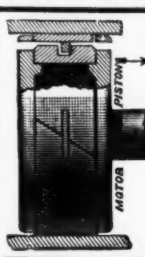

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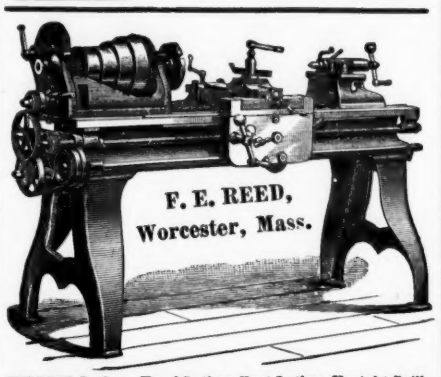

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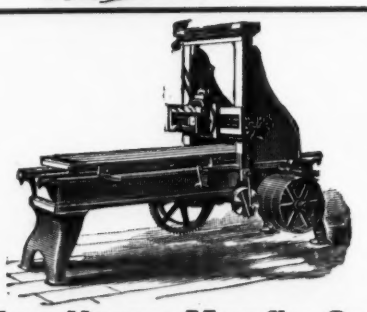

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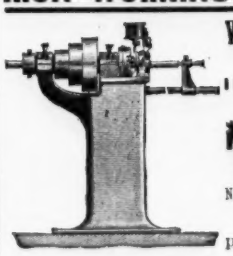

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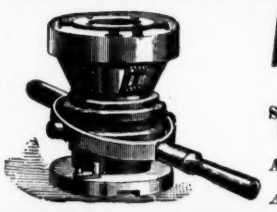

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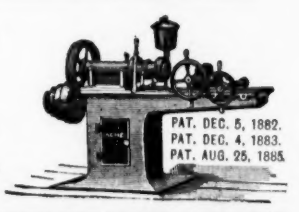

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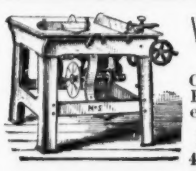

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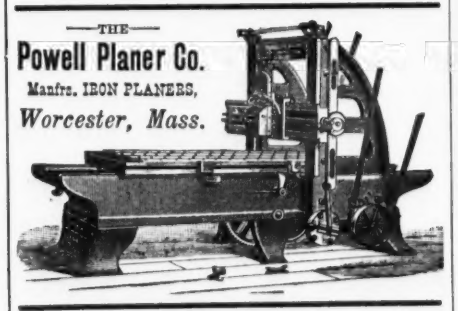

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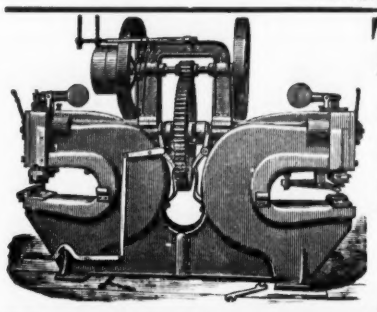

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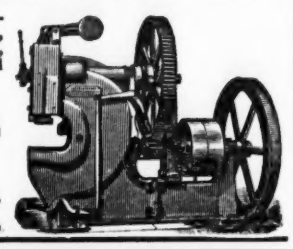

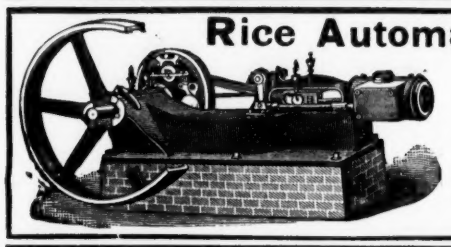

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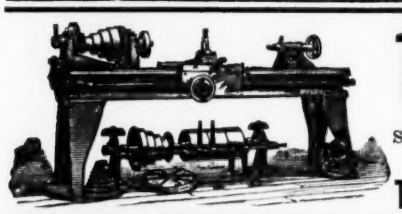

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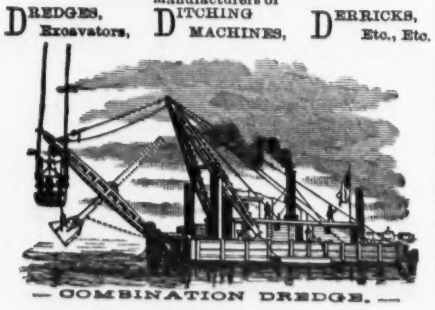

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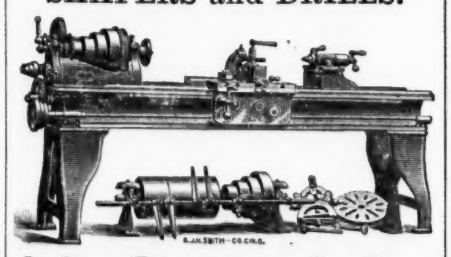

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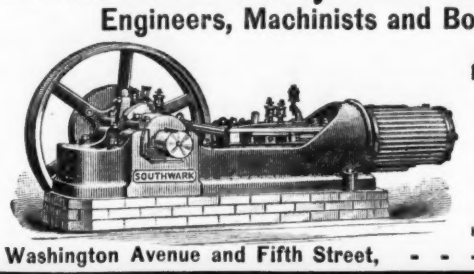
TAPPING and
REAMING MACHINES,
Portable Drills,
ALSO FLEXIBLE
BORING MACHINES

For Ironing Carriages and Wagons; Boring for Pinning Sash, Doors and Blinds, also for Stair Work.

E. P. B. SOUTHWORTH,
94 Exchange street, Rochester, New York.
Indicating Engineer and Mechanical Draftsman.
Correspondence solicited.

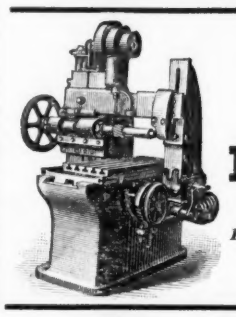
Southwark Foundry and Machine Company,

Engineers, Machinists and Boiler Makers,



SOLE MAKERS
Porter, Allen & Southwark Engines.
Blowing & Reversing Engines, Steel & Hydraulic Machinery, Boilers, Tanks, and Gas Apparatus.
INQUIRIES SOLICITED.

Washington Avenue and Fifth Street, - - - PHILADELPHIA, PA.



BEMENT, MILES & CO.,

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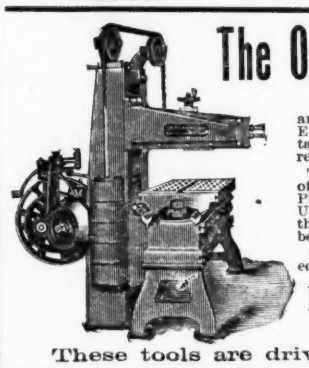
METAL-WORKING MACHINE TOOLS

FOR

Railroad Shops, Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.

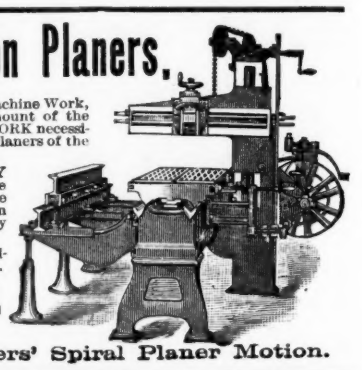
The Open Side Iron Planers.



Adapted for all classes of Machine Work, and especially for a large amount of the EXTRA WIDE and HEAVY WORK necessitating the Large and Costly Planers of the regular style.

The QUALITY and QUANTITY of work performed on these Planers is GUARANTEED to be UNEXCELLED by that done on the modern tools of the very best makes

Prices, phototypes and detailed information on application.

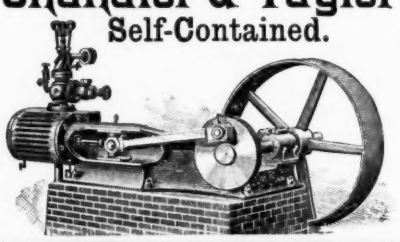


DETRICK & HARVEY,
Baltimore, Md.

These tools are driven by the Sellers' Spiral Planer Motion.

Chandler & Taylor's STEAM ENGINES

Self-Contained.



Are Strong, Well-Built and Serviceable.
Are designed for Heavy and Continuous Work.
May be run at High Speed when desired, performing the duties of High Grade Engines,
And are sold at the prices of ordinary Engines.

For Prices and Descriptive Circulars, address

CHANDLER & TAYLOR,
INDIANAPOLIS, IND.

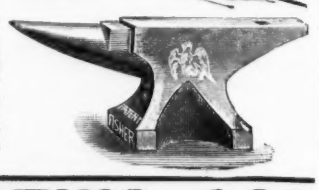
EAGLE ANVIL WORKS,

Trenton, N. J.

The Fisher Double Screw Leg Vise.—Warranted stronger grip than any other Vise. Always parallel and cannot be broken.

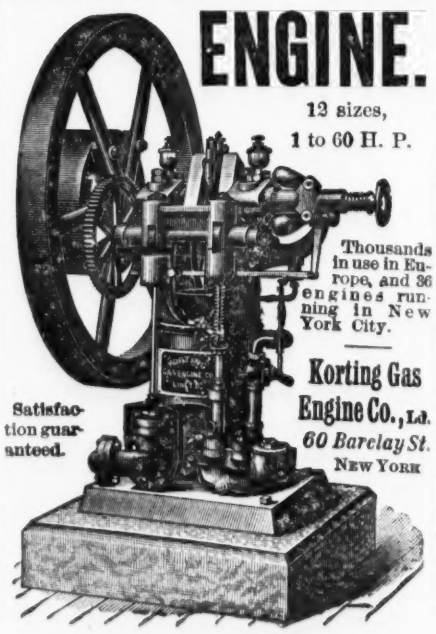
Send for Circulars.

The Eagle Anvil.—Best Cast Steel Face & Steel Horn. Better than any English anvil. Fully warranted and lower price.



KORTING GAS ENGINE.

12 sizes,
1 to 60 H. P.



Thousands in use in Europe, and 36 engines running in New York City.

Satisfaction guaranteed.

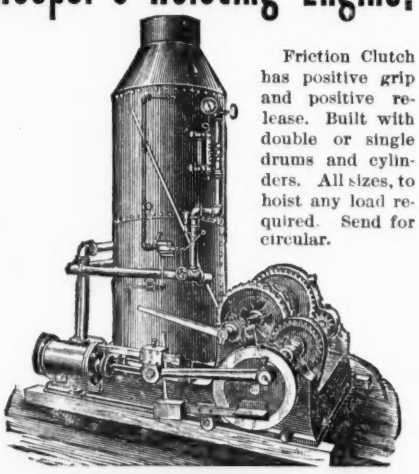
Korting Gas Engine Co., Ld.
60 Barclay St.
NEW YORK

FRICTION CLUTCH PULLEYS,

HOISTING ENGINES, ELEVATORS, STEAM AND BELT POWER.

D. FRISBIE & CO., 112 Liberty St., N. Y.

Hooper's Hoisting Engine.



Friction Clutch has positive grip and positive release. Built with double or single drums and cylinders. All sizes, to hoist any load required. Send for circular.

BUILT BY **ALEXANDER TRAUD,**
East Ferry Street Iron Works
NEWARK, N. J.

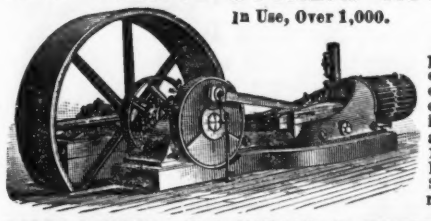
BARGAIN LIST.

One Plain Milling Machine		Second Hand.
Three Index	"	" "
Two 70 H. P. Stationary Boilers		" "
One 75 H. P. " Engine		" "
" 20 H. P. Vertical	"	" "
" 15 H. P. "	"	" "
" 10 H. P. "	"	" "
" 8 H. P. Portable	"	" "
" 80 H. P. "	"	" "
" 75 H. P. "	"	" "
" 30 H. P. " Steam Saw Mill, with 52" Saw and all Fixtures complete.		
One Surface Planer, S. A. Wood's make, Second Hand.		
One 16 ' Swing 6 ft. Bed Engine Lathe, Second Hand.		
" Danish Weston Hydro Extractor.	"	"
" 60 ' Blackman Exhaust Fan	"	"
" No. 3 Sturtevant Blower	"	"

S. L. HOLT & CO.,
67 SUDBURY ST., Boston, Mass.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.

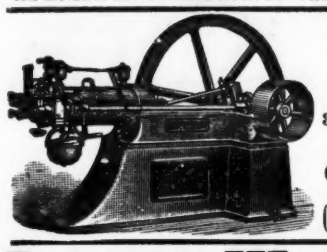


These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H P for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. Address, BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS: W. L. SIMPSON, 301 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. {N. W. ROBINSON, cor. Clinton & Jackson Sts., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.



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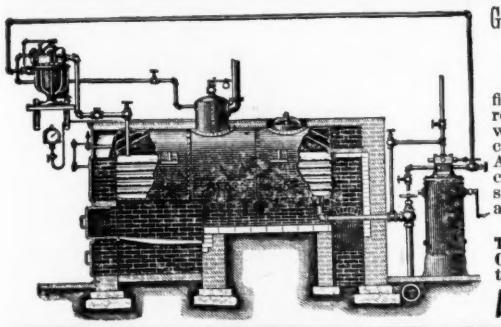
SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts. PHILADELPHIA. Branch Office, 130 Washington St. CHICAGO.

OVER 20,000 ENGINES IN USE.

GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

BLESSING'S WATER CIRCULATOR AND PURIFIER

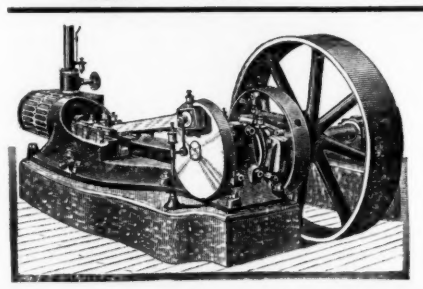


Guaranteed to Absolutely Prevent Formation of Scale in Steam Boilers.

Automatically takes water from the boiler, filters it, and returns it in pure condition, thus removing scale-making impurities from the water, and maintaining a free and steady circulation. Combines the well-known Albany Steam Trap with a Filter of novel construction, which has no rival in point of simplicity, facility for cleaning, and assurance against clogging of sand valve.

Send also for Circulars of Albany Steam Traps, Blessing's Renewable-Seat Stop and Check Valves, Pump Governors, Water Circulators and Purifiers, etc.

Albany Steam Trap Co., ALBANY, N. Y.



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BOILERS, ETC.

Complete Power Plants Furnished and Erected.

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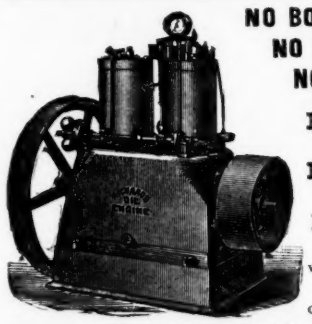

NO BOILER. NO STEAM. NO DANGER.

FUEL, CRUDE PETROLEUM OR KEROSENE.

Started instantly with a match.

Cheaper than all others.

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ECONOMICAL STEAM BOILERS

A SPECIALTY.

SEND FOR PRICES Pond Engineering Co. St. Louis, Mo.

MACHINE TOOLS.

NEW AND SECOND-HAND, ON HAND.

12 in. x 6 ft.	Engine Lathe,		new
13 in. x 6 ft.	"	Ames,	"
14 in. x 6 ft.	"	Blaisdell,	"
16 in. x 6 8-10 & 12 ft.	"	Bridgeport,	new.
16 in. x 6	"	Blaisdell,	"
18 in. x 8 ft.	"	Blaisdell,	"
19 in. x 14 ft.	"	Pond,	nearly new.
18 in. x 10 ft.	"	Lathe and Morse,	fair.
20 in. x 10 & 12 ft.	"	Ames,	new.
24 in. x 10 14 & 20 ft.	"	Ames,	"
28 in. x 12 & 14 1-2 ft.	"	Bridgeport,	"
24 in. x 16 ft.	"	New Haven,	good order.
30 in. x 14 ft.	"	W. and L. pattern,	new.
42 in. x 16 ft.	"	Ames,	"
54 in. x 30 ft.	"	Niles,	good as new.
16 in. x 42 in.	Planer	Bridgeport,	new.
22 in. x 4 ft.	"	Pease,	new.
22 in. x 4 5-4 6 ft.	"	Powell,	"
22 in. x 5 ft.	"	Hendey,	new.
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26 in. x 5 ft.	"	Biglow,	"
26 in. x 7 ft.	"	Brettell,	new.
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30 in. x 8 ft.	"	Hewes & Phillips,	new.
60 in. x 10 ft.	"	Powell,	
36 in. x 12 ft.	"	Niles Tool Works,	A 1.
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12 in.	"	Hewes & Phillips,	"
13 in. Stroke, 9 ft. Bed, Trav.		Head Shaper, Barr,	A 1.
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16-18-20-23-25-28-34 in. Drills.		30 in. Radial Drill.	
13 in. Stroke Slotter		H. & P.	new.
Center Bolt Cutter,			new.
50 in. Boring and Turning Mill.			A 1.
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Merrill Drops, 800 lbs.			good order.

Bement 2250 lb. Steam Hammer.
Milling Machines, Screw Machines, Slate Sensitive Drills.
Gang Drills, and full line of all kinds of Machine Tools.
Send for list and specify what is wanted.

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To Buyers of Engine Lathes

We are now making from entirely new designs, *extra heavy* 19" and 21" Engine Lathes (the most popular sizes), of which we are making a specialty, and manufacturing in lots of not less than 100 at a time.

We make no charge for extras. Every lathe is furnished with *hollow spindle*; the 19" with 1⅝" hole, and 21" with 1⅞" hole. Every lathe has substantial *compound rest*, heavy tool post (bar steel), rest to turn full swing, *following rest* with adjustable jaws to take any size from 2½" down, with extra tool for shafting.

Full set of gears to cut from 2 to 18 threads including 11½ pipe thread. *Automatic stop on carriage. Separate screw and rod feed*, and the most substantial and easily managed *taper attachment* made. Cones and gears of large diameter and wide belt. Studs, screws and small gears are *steel or gun metal*. Webbed live heads, heavy tail stocks. No worm or worm gears, no weak reverse plate. *Perfect lubrication for all running parts*, including carriage.

Lead screw inside of shear, double nut (cut from solid), and taking hold of carriage directly under the line of strain. Friction counter-shaft, the most durable made. Our prices are reasonable for cash, and from which no deviation will be made. Our written guarantee accompanies every lathe.

GUARANTEE.

We guarantee this lathe to be equal in workmanship, truth, accuracy, solidity, material and finish, to the best made, and hold ourselves legally liable for this guarantee.

LODGE, DAVIS & CO.

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Machine Tools,

159, 161, 163 and 165 EGGLESTON AVE.,

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(See our advertisement on last page.)

The Watts, Campbell Co.,

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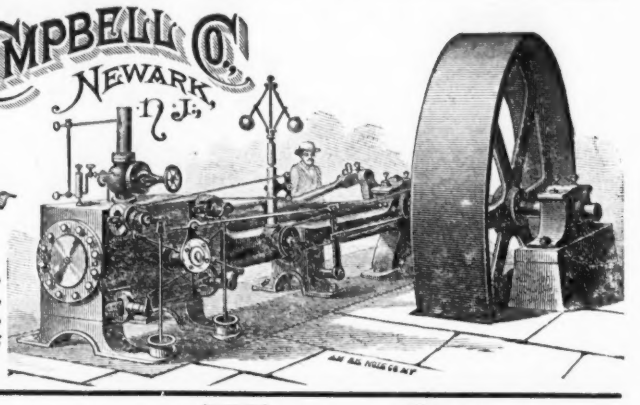
MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.



Sizes Varying from 30 to 2000 Horse Power.

Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound.

Send for Circular.

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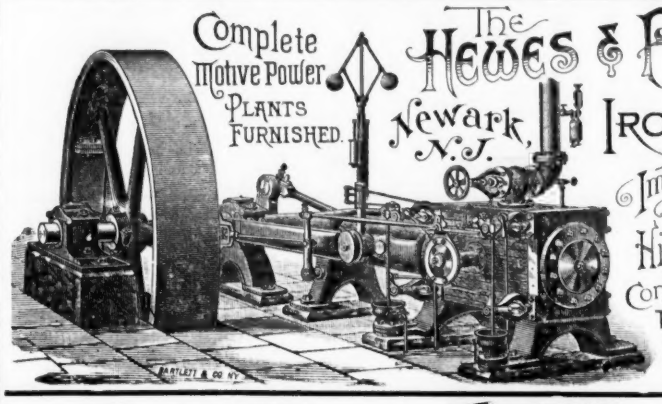
Complete Motive Power Plants Furnished.



Improved CORLISS ENGINES, High Pressure, Condensing and Compound

TUBULAR BOILERS.

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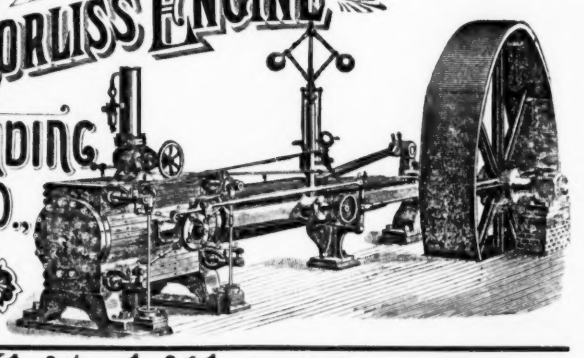
THE IMPROVED FISHKILL CORLISS ENGINE

BUILT BY THE FISHKILL LANDING MACHINE CO.,

FISHKILL ON THE HUDSON, N.Y.



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MANUFACTURER OF IMPROVED CORLISS ENGINES

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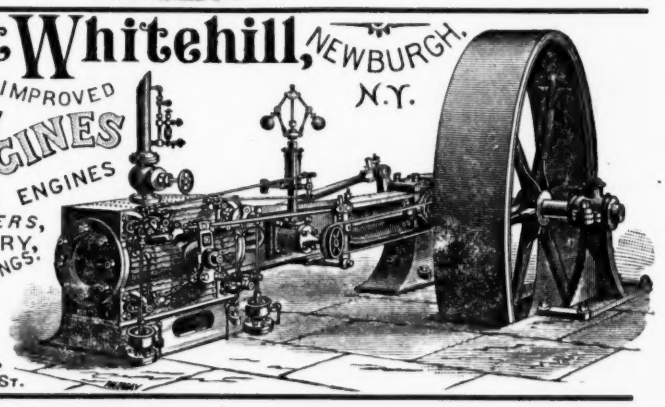
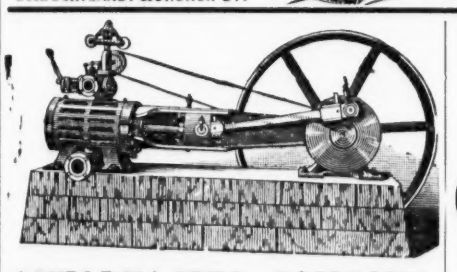
STATIONARY BOILERS, GENERAL MACHINERY, IRON AND BRASS CASTINGS.



NEW YORK OFFICE Room 6, COAL AND IRON EXCHANGE, Cor. Cortlandt & Church St.



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Engines from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

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Having enlarged our Foundry and otherwise added to our facilities, we are prepared to execute orders for castings weighing from a few pounds to *forty tons*. Our Boring and Turning Mill is one of the largest in the United States, by which we can bore and turn a wheeel or cylinder up to 30 feet in diameter, and we can plane 30 feet long by almost any width. With our *unsurpassed* means for handling heavy work, and shipping *by boat or rail*, we are enabled to

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We make a specialty of machinery for making Sugar, and furnish everything necessary to fully equip Sugar Refineries or Plantations. Satisfaction guaranteed, and patronage solicited.

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JOHN McLAREN,

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BUILDER OF

CORLISS ENGINES,

AIR COMPRESSORS AND BOILERS.

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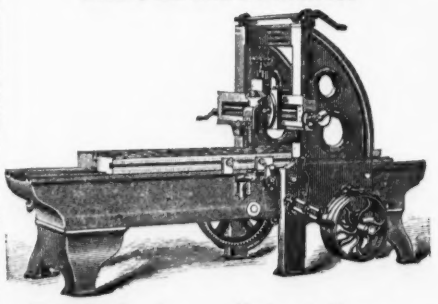
Sizes, 22 and 26 Inches.



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26 in. x 26 in. x 6 ft.

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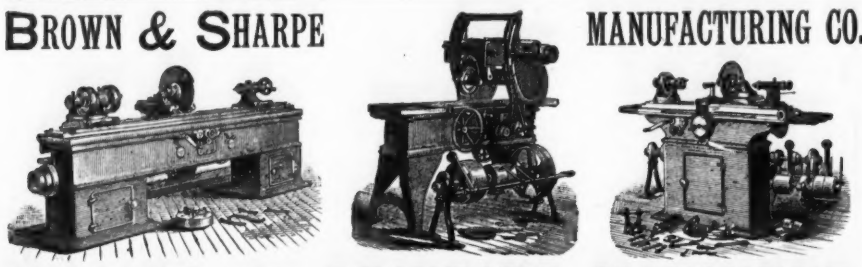

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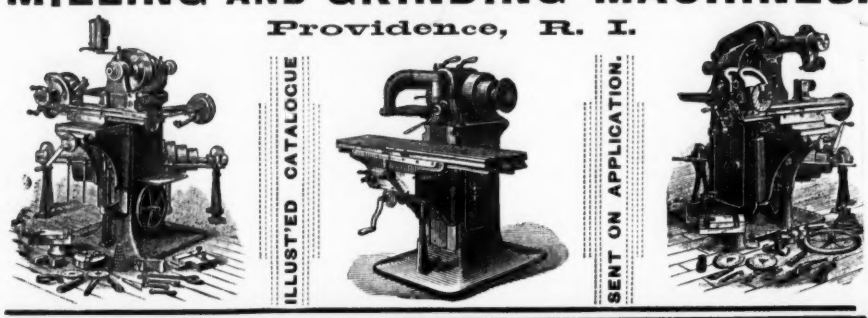
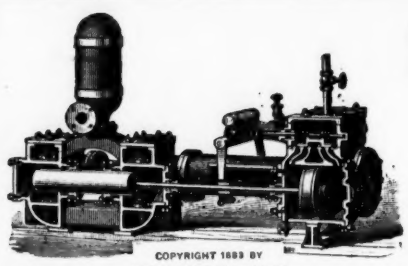


ILLUST'ED CATALOGUE

SENT ON APPLICATION.



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Duplex Steam Pumps

—AND—

WATER WORKS MACHINERY.

THE GORDON & MAXWELL CO.

HAMILTON, OHIO.

BRANCH HOUSES:

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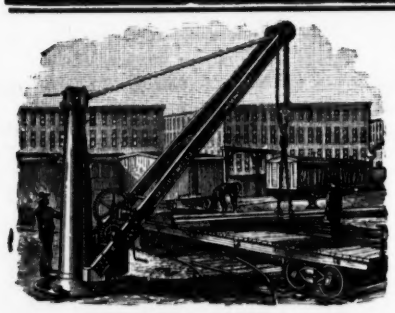


PILLAR CRANE

PILLAR CRANES,

ANY CAPACITY.

Descriptive Circulars on application, and full Specification and Tender promptly submitted on receipt of capacity, height of hoist and effective radius desired. Standard sizes in stock.

SOLE MAKERS,

THE YALE & TOWNE MFG. CO.

STAMFORD, CONNECTICUT.

New York — Chicago — Philadelphia — Boston.

Catalogues on application.

ENGINE LATHES, SHAPERS & DRILLS.

20-INCH LEVER DRILL.

26-INCH BACK GEARED AND POWER FEED DRILL.

20 in. Upright Drill.
24 " " "
26 " Back Geared
30 " and
38 " Power Feed Drills.

LODGE, DAVIS & CO.

CINCINNATI, OHIO.

Send For Prices. It Will Pay You.

(See special notice of Engine Lathes on page 15.)

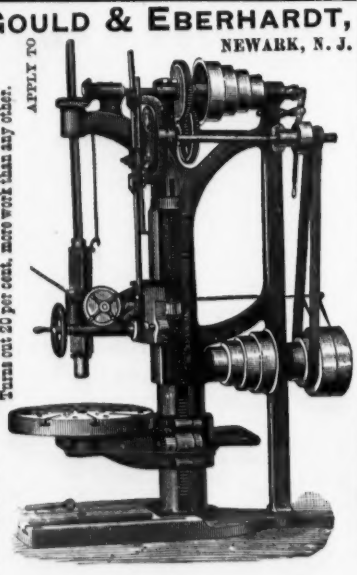
E. GOULD & EBERHARDT,

NEWARK, N. J.

Eberhardt's New Drill

APPLY TO

Turns out 20 per cent. more work than any other.



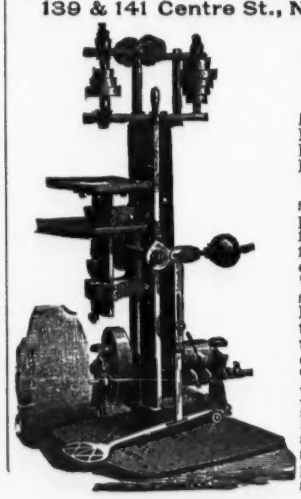
E. E. GARVIN & CO.,

139 & 141 Centre St., New York,

Manufacturers of

Machinists' Tools,

Including Milling Machines, Drill Presses, Hand Lathes, &c.



The machine shown in cut, is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

THE PRATT & WHITNEY CO.,

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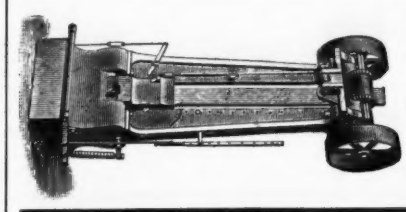

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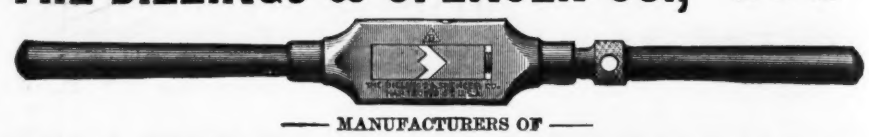

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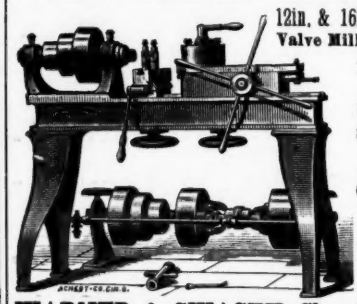

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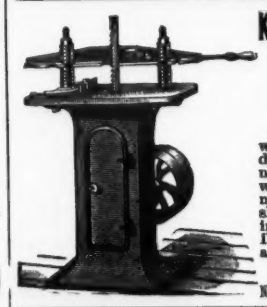

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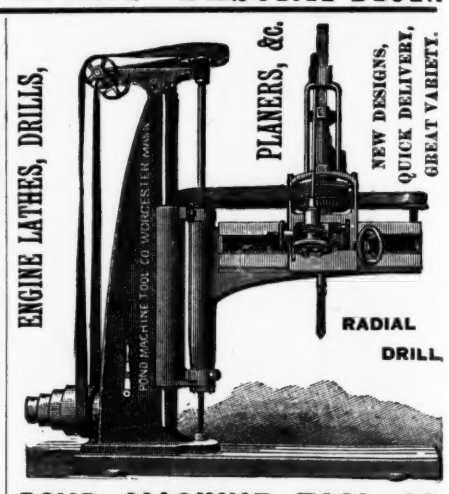

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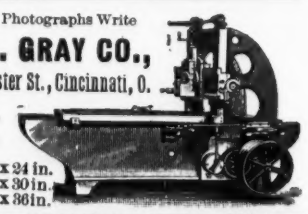

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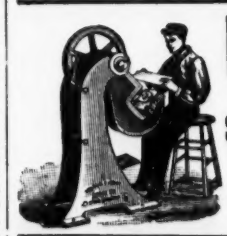

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